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T. C. Martin and W. D. Weaver, - - - - - - Editors.
T. R. Taltavall, - - - - - - - - - Associate Editor.
Carl Hering, - - - - - - - - - Special Contributor.

J. M. Wakeman, - - - - - President and General Manager.
T. C. Martin, - - - - - - - - - Vice-President
A. C. Shaw, - - - - - - - - - - - Secretary.

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The Nernst Lamp.

Whatever may be said concerning the novelty or the present degree of perfection of the Nernst lamp, there can be no doubt that its perfection is greatly to be desired, for the reason that it would enable higher pressures to be delivered to incandescent lamps of the new type with marked economy. It would be a great advantage to the engineer to be able to supply pressure of 500 volts properly safeguarded into buildings for the direct supply of incandescent lamps, on the ordinary two-wire system. At the present time, the engineer is limited to 220 volts on this system.

The high temperature of the Nernst prism produces changes in electrical condition that are surprising to the student who has not familiarized himself with this branch of thermo-electricity. It is a remarkable fact that a glass rod or stout tube heated to a bright red heat in the blow-pipe will carry an electric current under a pressure of, say, from 500 to 1000 volts, of such strength as to bring the glass to its melting point, and at the same time, to cause the glass rod to incandesce brilliantly. Under these conditions, we have a rod of glass, which is properly regarded as one of the best of non-conductors, giving free passage to an electric current of appreciable strength and acting as a veritable glow lamp. As may be surmised, however, the glass glow lamp does not last very long, since it is steadily melted and destroyed, but the experiment can be made to last several minutes and is a fascinating one to an electrical audience.

The experiment illustrates, moreover, the wonderful effects of temperature upon the conducting power of substances. As metals cool, they become better and better conductors, until we have reason to believe that at or near the absolute zero, some of them would have infinite conductivity. As non-metals cool they become as a rule worse and worse conductors and glass at the melting point of ice, is considered to have one of the highest resistivities ever measured. Yet glass at the temperature of its own melting point has quite a low resistivity.

The Forces Acting on the Conductors in Slotted Armatures.

An article which appears in another column draws attention to the fact, now seemingly well established, that in the case of a smooth-core armature in which the conductors all lie upon the external surface, the force exerted electromagnetically upon the armature is entirely active on these conductors; whereas, in the case of toothed-cored armatures, in which the conductors lie buried in grooves, tunnels or slots, the electromagnetic force is almost entirely exerted upon the iron surface-projections of the core, and only a small residual portion of this force is exerted upon the buried conductors. The facts are most fortunate from the standpoints of the dynamo designer and constructor, since it used to be a matter of great difficulty in the smooth-cored armatures to attach the conductors so firmly to the core that they could communicate the tangential force safely to the latter, without danger of being torn away, even at violent overloads. At the present time, the magnetic forces brought to bear upon the buried conductors of the modern tooth-cored armatures are so small that practically the only forces to be safe-guarded are centrifugal and gravitational forces.

The fact that buried armature conductors escaped magnetic force was at first regarded as paradoxical, if not impossible, but now that the facts appear to be generally supported by ample experimental

evidence, it is not difficult to see how the phenomenon can be accounted for. In the smooth-cored armature, the conductors lie in a powerful magnetic field and consequently the current which they carry is urged sideways with a correspondingly strong magnetic force. In the tooth-cored armature, the conductors are never situated in a powerful magnetic field, whether the armature be at rest or running. In fact, in the simplest theoretical case in which the conductors lie within a tunnel of unsaturated iron, the magnetic field in which the encased conductor lies is merely the field due to its own current, and is not affected by the field due to the action of the field magnets. Consequently, the magnetic force brought to bear upon the conductor is no more than if the field magnets were entirely removed.

For evidently corresponding reasons, the iron cores of the two armatures compared, behave differently. In the smooth-cored armature there is no magnetic force acting upon the core to produce rotation. On the contrary, the only magnetic force which is exerted is that due to hysteresis and which steadily resists rotation. In the tooth-cored armature, however, the teeth or projections are magnetized by the action of the current in the armature conductors, and, as magnetized bodies, are subjected to the magnetic field of the field magnets, with the result that they are urged forward. The wonderful fact is that the force which in this complex condition acts upon the armature is just the same as when the force is exerted upon a simple collection of armature conductors carrying currents.

ELECTRICAL HAULAGE OF FREIGHT.

The decision of Justice Marean, of the Supreme Court of this state, permitting the haulage of freight over street trolley systems is very important as indicative of the trend of things. There had been an effort made to stop the running of express cars on the trolley lines in Jamaica, Long Island, but Juge Marean dismissed the case for lack of sufficient ground for action. He noted the fact that at one time the public had not demanded facilities of this nature, but now "having discovered that the transportation of freight can be made more economically than by former methods, there is no meritorious reason why it should not enjoy that advantage." He remarks that while it would obviously be impracticable to stop on call for freight with a passenger service, nothing is more practical and easy than organizing depots, switches and times of transportation. Even the impracticability is not quite so obvious as Judge Marean assumes, for at the present moment trolley express cars are run on all the street car lines of Pittsburg and Allegheny, and it is said that the receipt of delivery of a package is working out to occupy about the same time as picking up or setting down a passenger.

In short, trolley expressage is already here, and its arrival should be a hint or lesson as to automobile freighting of goods. The public, including not a few electrical people, is all too ready to assume that the use of the electric automobile will be limited to passenger work, ply-for-hire business and private carriage service. That remains to be proved, and if it be true that the tests with electric trucks show a power expenditure not in excess of 1 cent per ton-mile, the future is not dark but bright. The tendency of the roadway beds is to improve, and what the bicycle has begun in the betterment of roads, the automobile will continue.

Besides, engineers are not at the end of their resources in this respect. Asphalt is by no means the final word in the matter of making smooth streets. We have seen lately some glass paving that has already been laid in France, and from which excellent results may well be expected. But the "metalling" of roadways is no longer to be limited to the use of material that is not metal. Secretary Wilson, of the United States Department of Agriculture, is a warm advocate of the plan of laying steel track wagon roads, the track consisting of two parallel lines of flat steel plates, about eight inches wide, laid far enough apart to accommodate the wheels of any vehicle of standard gauge. The experiments already conducted show that such track roads are far superior in traction results to dirt and macadam roads. At the present time, the cost of such roadway complete will not exceed $3,000 per mile, at which rate, in view of its permanence, durability and superior tractive qualities, a great many communities will find it a good thing to put down. The extension of automobilism will be a natural consequence. Perhaps the matter might be put the other way around by saying that automobilism will lead to the construction of these roads just as bicycling has created the innumerable bicycle paths all over this great country.

WIRELESS TELEGRAPHY.

At the British Association meeting in 1896, Mr. W. H. Preece introduced to the world the Marconi system of wireless telegraph, which had then been successfully experimented with in sending messages over distances up to 1¾ miles. In a lecture before the Royal Society in June of the next year, Mr. Preece reported that messages had been sent through nine miles of space, which distance a few months later was increased to twelve miles, and within the year to eighteen miles. Though these results were reported at the time in the electrical and other scientific journals, and though one of the features of the electrical exhibition of last year at Madison Square Garden was a working exhibit of the wireless telegraph, it is only recently that the American public appears to have become interested in the subject.

For some time past despatches have appeared almost daily in the newspaper press, chronicling that Prof. This or Mr. That had succeeded in transmitting messages by means of wireless telegraphy through a few thousand feet or yards, this information carrying with it the implication that the experiments reported were advances in the art, and reflected great credit upon the experimenter. Though recently full accounts have appeared in our columns and in other journals of the continous and satisfactory operation of the system for some months between the South Foreland lighthouse and East Goodwin lightship; that for weeks messages were sent without interruption across the English channel over a distance of 28 miles; that Prof. Pasqualini has signaled to and from a torepdo boat 24 miles at sea—notwithstanding the state of the art abroad which this implies, we continue to be regaled with newspaper accounts of experiments that in results are inferior to what Marconi achieved three years ago. The inference to many acquainted with what has been done abroad is apt to be that either those who figure in the newspaper reports consider the foreign standard so much beyond the American one that it may be ignored, or that they are merely seekers after newspaper notoriety.

In another column we print a note concerning M. Ducretet's successful experiments in wireless telegraph in and about Paris. No difficulty was apparently met in transmitting messages between the various stations established, yet with the exception of some experiments by Mr. A. V. Abbott in Chicago, the attempts heretofore made in several of our cities have either been entirely unsuccessful, or partially successful over but short distances. An excuse offered for failures in this line has been that the iron frames of office buildings interfered with the transmission. Though there is a probability that this assumption may be true, we are not aware that it has been subjected to experimental test. At any rate, it would not apply if free space intervened between the aerial conductors at the two

stations, if the theory be correct that the ether disturbances are propogated in horizontal circles concentric with the aerial conductors. It has been proposed to transmit messages during the present New York electrical exhibition between the tower of the *World* building and that of Madison Square Garden. In view of the experiments of M. Ducretet in Paris, there is every probability that with proper instruments and competent skill the experiment can be successfully made. In any event it would be more compatible with our real place in the scientific world if experimenters confined their announcements to the press to achievements comparable with what has already been done abroad.

A REMARKABLE SWITCHBOARD.

The development of switchboard design during the past few years has been more revolutionary than that of any other part of central station euqipments. The switchboard was first considered only an accessory and incidental to the more important boilers, engines and dynamos in the production of electrical power. Board was a good name for the arrangement then used, consisting as it did of a wooden skeleton with switches and instruments largely built of wood, such as are still familiar in many old installations. Now the switchboard apparatus is recognized as even more vital to the continuity of the station output, as well as its control and regulation, than is any other part of the equipment. If a boiler fails or an engine breaks down, others may be at hand to take their places, and even failures of the steam piping can be provided against, but any one of many faults in the switchboard is quite likely to interfere with or even cause a lengthy stoppage of the station supply. The enormous amount of power concentrated in boards of large stations makes many small faults likely to develop into serious catastrophies. The switchboard also has come to be recognized as properly the most ornamental part of the station equipment, and has received a lavish embellishment, the expense of which is justified by the moral effect upon the station operators and the added care they take to keep the rest of the equipment in a state of neatness and general ship-shapeness that will not disgrace the handsome appearance of the board. For these reasons, the switchboard, from being the most neglected and slouchy part of the equipment, has risen to the highest position of perfection and ornamentation.

A board which has necessarily received unusual study on account of the size and number of machines which it handles is that of the Boston Electric Light Company, described on other pages in this issue. One of the most novel features of this board is the use of aluminum bus bars. As is well known, the cost of aluminum per ohm foot as an uninsulated conductor is at present market prices below that of copper. The advantage of the former metal in this instance was the 50 per cent. saving in weight, which, on account of the many heavy bus bars in this board, allowed a considerable reduction in the cost of the supporting structure. In general, the objections to the use of aluminum for such purposes seem to be few and slight, so that should the cost of aluminum per unit conductivity remain below that of copper, and especially wherever a saving in weight is desirable, bus bars and switchboard wiring in general may, with advantage, be made of aluminum. The cross-section of aluminum for the same conductivity must be about 50 per cent. greater than that of copper, necessitating, if the same shape is retained, an increase of the breadth and thickness of a bus bar by about 20 per cent. On the other hand, this increase gives a slightly larger radiating surface which tends to keep the temperature down. The remarkably high heat conductivity of aluminum is also an advantage in that it tends to conduct away, distribute and dissipate excessive heating at bad joints or other points of high resistance. For these reasons little danger need be feared of overheating bus bars laid out on a basis of the same conductivity as standard copper bars. In the particular plant referred to, the cross-section is, as a rule, laid out on the basis of a maximum current density of 500 amperes per sq.in. In the matter of joints no particular difficulty has been found in this particular installation, the conducting faces at joints being milled to a true surface and clamped together in the usual way.

NEW METHODS OF SHUNT EXCITATION.

On another page we print an account of an American patent just issued to Prof. Sengel, of the Darmstadt Electro-technical Institute, which relates to a most interesting method of shunt excitation whereby the shunt coil is supplied with a voltage half that of the armature brushes. Aside from the intrinsic interest of the method described owing to the principle concerned, it would appear to have a considerable commercial value, particularly with respect to 220 and 500-volt constant-potential machines and direct-current shunt motors. In both cases the application of the methods will reduce the resistance of the shunt winding one-fourth. In the case of the motor there will be the additional advantage that in starting up, the shunt coil will be subjected to double the voltage that will exist at its terminals after the machine has attained normal speed.

The principle of the method is so simple it is somewhat surprising that it has not previously been utilized. A single bar of the commutator is connected with a collector ring on the armature shaft, and the brush of the ring connected to one side of the shunt coil, the other side being connected to either one of the armature brushes. The e. m. f. at the armature terminals will consequently be pulsating in character, varying between zero and the voltage of the machine. But such a pulsating e. m. f. is equivalent to a combined direct e. m. f. and an alternating e. m. f., the direct e. m. f. and maximum value of the alternating e. m. f., being half that at the armature brushes. Owing to the large self-inductance of a shunt winding, but a small part of the alternating e. m. f. will pass through it—corresponding to the leakage current of a transformer on open circuit—and this will generate an inductive e. m. f. which will stop further flow of alternating current. The consequence is that the shunt winding will be practically subjected to a direct e. m. f. of one-half the value of that of the machine, so that the winding will have but one-fourth the resistance of the usual shunt winding. A saving in cost will thus result in the case of small and high voltage machines. In addition, owing to the smaller inductance of the winding, there will be less liability of damage by puncturing in case of breakage of the shunt circuit. In the case of a motor, this system introduces, as stated above, an additional advantage, since the shunt motor winding may be subjected to the full voltage of the line in starting, thus increasing the starting torque.

Another method of accomplishing a result similar to that just described was patented some months ago by Mr. W. B. Sayers, but has an additional advantage that it enables a shunt winding to be also used for compounding. In this method a small third brush bears on the commutator midway between the two main brushes, one end of the shunt winding being connected to this brush and the other end to one of the main brushes. At no load the shunt winding will thus be subjected to only half the voltage of the machine, as in the Zodel method. As the load increases, however, the distortion of the field will increase the voltage between the main and small brush, and as this effect is approximately proportional to the load within wide limits, the result is that the machine may be compounded or over-compounded without any series winding. Owing to the small current passing through the third brush, which need not be ordinarily over one-fourth of an inch wide, no trouble is experienced from sparking.

The National Electric Light Association Programme.

The general programme for the convention of the National Electric Light Association this week has already been given in these pages. The assignments of the different papers and topics have now been announced as follows: Tuesday morning session, Madison Square Garden, 10:30, address by President Young; paper by Mr. W. S. Barstow, "A Local Transmission System: Development and Operation;" report by Chairman Brophy from Committee on Standard Rules for Electrical Construction and Operation;" afternoon session, paper by Prof. W. L. Robb on "Rotary Transformers and Storage Batteries as Related to Long Distance Transmission;" topic, "Transformer Tests."

Wednesday morning session, 10 A. M., paper by Mr. Herbert A. Wagner, on "Single-Phase Distribution;" paper by Louis A. Ferguson, on "Underground Electrical Construction;" afternoon session, 2:30, paper by E. A. Leslie, on "Some Notes on Underground Distribution of Two-Phase Current in New York City;" paper by W. L. R. Emmet, on "Means of Affording Safety in Electrical Distribution;" report by Dr. Louis Bell, chairman, from Committee on Sandard Candle-Power of Incandescent Lamps; report from Judge E. A. Armstrong, chairman Committee of Legislation Regarding Theft of Electric Current. Evening session, concert hall, Calvin W. Rice, illustrated lecture on "The Development of High-Tension Service."

Thursday morning, 10 A. M., paper by H. M. Atkinson, on "Alternating Current Generation and Distribution—Changes Contemplated in Atlanta, Ga.;" report, James I. Ayer, chairman, Committee on Amendments to freight Classification; report, Samuel Insull, chairman, Committee on Legislative Policy. Afternoon session 2:30, report, Paul Spencer, chairman, Committee on Sandard Specifications for Electrical Apparatus; report, John A. Seely, chairman, Committee on Finance; reports of secretary and treasurer and Executive Committee; election of officers.

The badges of the association will carry red ribbon for officers, blue for Executive Committee, purple for active members, mauve for associate members, yellow for Reception Committee, yellow and white for the Entertainment Committee and white for honorary members.

On Wednesday afternoon an automobile ride will be given to the ladies of the convention from the Garden to Grant's Tomb on Riverside Drive; Columbia University, where 5 o'clock tea will be taken, and the electric stables of the New York Electric Vehicle Transportation Co. On Thursday afternoon, a steamboat trip will be given around the waters of Manhattan Island from Yonkers to the Navy Yard and Narrows. On Friday a special train will take a select party to the General Electric works at Schenectady. On Friday evening Mr. Chas. E. Tripler will lecture on "Liquid Air," at the Garden before the association. There are many private entertainments scheduled for the week. On Tuesday evening Dr. W. M. Habirshaw gives a dinner party at Delmonico's. On Thursday evening the electrical members of the Lotos Club will give a dinner to the leading members of the association.

Virginia Street Railway Convention.

The Street Railway & Electrical Association of Virginia held their first annual meeting at the Hotel Jefferson, Richmond, Va., on May 16th. The following representatives of the various companies forming the association were present: R. D. Apperson, Staunton, Virginia Street Car Company; Howard P. Page, Norfolk & Ocean View Railway Company; Wm. Roxborough, Norfolk Railroad Company; J. R. Curtis, General Electric Company; C. W. Uthoff, Columbia Incandescent Lamp Company; Julian Binford, Jr., Tower-Binford Electric & Manufacturing Company; E. R. Williams, Richmond Traction Company; R. A. Byrns, Ohio Brass Company, New York; William Todd, Virginia Electrical Railway & Development Company, Richmond; E. W. Trafford, Richmond Railway & Electric Company; C. T. Phillips, City Street Car Company, Staunton; R. D. McClure, City Street Car Company, Staunton; J. A. Cooke, Richmond Traction Company; W. P. Woodson, Lynchburg & Rivermont Street Railway Company; T. P. Cowardin, Richmond Traction Company; R. L. Williams, Norfolk Street Railroad Company. The following papers were read: R. D. Apperson, "Track Bonding"; W. P. Woodson, "How to Increase Revenue of Electric Light Stations"; E. R. Williams, "Park Amusements"; J. R. Curtis, "The Use of the Wattmeter on Electric Cars to Check the Unnecessary Use of Current." Later the association were the guests of the Richmond Traction Company at a dinner given at the Jefferson Hotel, and afterwards were carried over its lines.

Electric Railroading in Jamaica, West Indies.

Mr. Louis A. Dent, United States Consul at Kingston, Jamaica, West Indies, gives an interesting account of the electric road recently put in there and driven by water power. For some years, there has been a mule railway in Kingston, but an electric road covering the lines of the old cars and other thoroughfares as well has just been completed. This new line has about 25 miles of track in and around Kingston, divided into three districts, viz., the lines north of the city, those east of the city, and those in the city. It is a private enterprise, started by Canadian capital, and is called the West India Electric Company. The government license is for a period of 30 years, renewable for further periods at the pleasure of the governor. The comany pays 4 per cent. of its gross earnings to the government, and assumes the maintenance of the roads and streets occupied by it to the extent of 18 inches on each side of the tracks.

The rates of fare are 4 cents for each passenger from any point within a district to another point in the same district by most direct route; that is, the fare is practically 4 cents for each section of the line, and from the end of the line to the east, through the city to the end of the line north, would be three fares or 12 cents. In addition, the company reserves three front benches on each car, on which a first-class fare—6 cents—is charged. The tickets are sold as follows: Seven 4-cent tickets for 24 cents, five 6-cent tickets for 24 cents, and ten children tickets, for under 12 years, for 24 cents.

Passengers are allowed to stand. There are no restrictions as to number of passengers carried, and the same complaints of overcrowding are heard. Cars run every 15 minutes in the city. In addition to regular motors, this company runs market cars before 9 a. m. and after 5 p. m. for country people who carry produce. These cars are trailers, and the fare on them is 3 cents.

Electrical Transmission of Power in Italy.

Italy is essentially a home of water-power development and electrical transmission, as is our Pacific Coast, but Venice, which is literally built in the sea and surrounded by miles of shallow lagoons and salt marshes, is a rather unexpected place to give birth to such an enterprise. About 50 miles from Venice, as the crow flies, among the foothills of the Alps, is the lake of Santa Croce, from which water is to be taken through an aqueduct about a mile and a quarter long to another lake called the Lago Morto, where a fall of some 330 feet can be obtained, which with the available water supply will develop some 20,000 horsepower.

A second canal will take the water to a third lake, the Lago Maschio, where another fall of 330 feet will be obtained, and another 20,000-hp developed. The energy will be electrically transmitted at high potential to Venice, Treviso, Conegliano and Pordeuone, where it will be consumed in industrial enterprises, several of which will be of an electro-chemical nature, such as the production of calcic carbide, aluminum and electrolytic copper, the raw materials for which are to be found round Belenno and Vittorio. About 10,000-hp will eventually be used by the state for traction purposes on the railways. It is also intended to make use of the waste water for irrigation purposes. It will probably be necessary to take water from the river Piave, during the dry season if the capacity mentioned above is to be maintained at all times.

A franchise recently granted to Gauz & Co., of Buda-Pesth, for the development of a water power in the river Panaro, in Narzole, is a case which illustrates forcibly the forethought that the Italian government is bestowing on the question of its water powers; these are numerous and are enhanced in value by the dearness of coal and wood, which are largely imported. The government takes the stand that the ownership of undeveloped water power is vested in the nation and not in the local communities, and it keeps before it the possibility of some day using this power on the state railways, and for other national enterprises, and is therefore careful to grant no concessions to private parties which might interfere with such a use.

Central Station of the Boston Electric Light Company.

THE recently completed central station of the Boston Electric Light Company can undoubtedly lay claim to the distinction of being the finest alternating-current station in the country. In fact, the engineering problems concerned have been so carefully worked out and details of the equipment so elaborately considered, that almost at a bound a level is reached in alternating-current station design that was only attained by years of evolution in the case of the Edison illuminating stations—for a long period the only plants in this country at all comparable with European stations in engineering design. The contrast which the present station presents to the former equipment of the same company is striking. Formerly there were four stations situated in different parts of the city and equipped with an assortment of belt driven machines that possessed more of an historic than any other interest, on account of the variety of types, sizes, speeds, etc.

The new generating station, of which a plan is given in Fig. 3, is situated on the water front in South Boston. The building has no architectural pretensions, being of plain brick on rough stone masonry foundations. The only striking exterior feature is the immense brick chimney, 225 feet high with an octagonal base of 22 feet between faces, and inside diameter of 11 feet.

COAL HANDLING EQUIPMENT.

An important appendage to the station is the coal hoisting and conveying apparatus, the former being at the end of a pier running 150 feet into the harbor. The hoisting apparatus consists of a movable crane or tower with a boom overhanging the vessel to be unloaded. This boom is swiveled so that its outer end can be swung in a horizontal plane in order to bring the hoisting chain immediately over the unloading hatch of the vessel. The boom can also be run back so as to clear the masts of vessels as the tower runs along the pier. It has a capacity of 100 buckets per hour, each bucket lifting a ton. The coal is dumped over a screen which sifts out the small coal, sending the large lumps to a crusher, the coal finally descending to the filler of a Hunt conveyor. The conveyor runs the entire length of the pier, discharging into the station pocket, and has altogether 742 buckets.

The hoisting gear of the crane is driven by a 500-volt motor on the Ward Leonard system, the generator being in the power house and its field rheostat in the tower. The crane is moved along the track by the same motor. A separate motor runs the crushing machine, and the conveyor is driven by a 15-hp General Electric induction motor, fitted with rotating resistance and short-circuiting devices in the secondary to give it a high starting torque.

The conveyor transfers the coal to the coal pocket of the station (Fig. 3), which runs the entire length of the building, or 240 feet, and is 30 feet wide, its capacity being 9000 tons of coal. The floor is above the boiler room level and coal passes from it through hoppers into small cars which carry the coal to the front of the furnaces.

BOILERS AND ENGINES.

The boilers are of the water-tube Babcock & Wilcox type, with triple drums. The normal rating is 550-hp each, but each battery of two is sufficient for one of the generating engines, which are rated at 2350-hp each on a consumption of 12½ pounds of water per horse-power-hour. The boilers are fitted with Hawley down-draft furnaces and deliver the gases to the chimney through a flue lined with fire brick, 6 feet by 11 feet in section, supported on I-beams fixed in the boiler room wall and the boiler setting, with a brick arch floor sprung between the beams. The boiler drums are covered with two inches of magnesia covering over which is a course of brick and Portland cement.

The generating room is a model in its finish. The walls are of

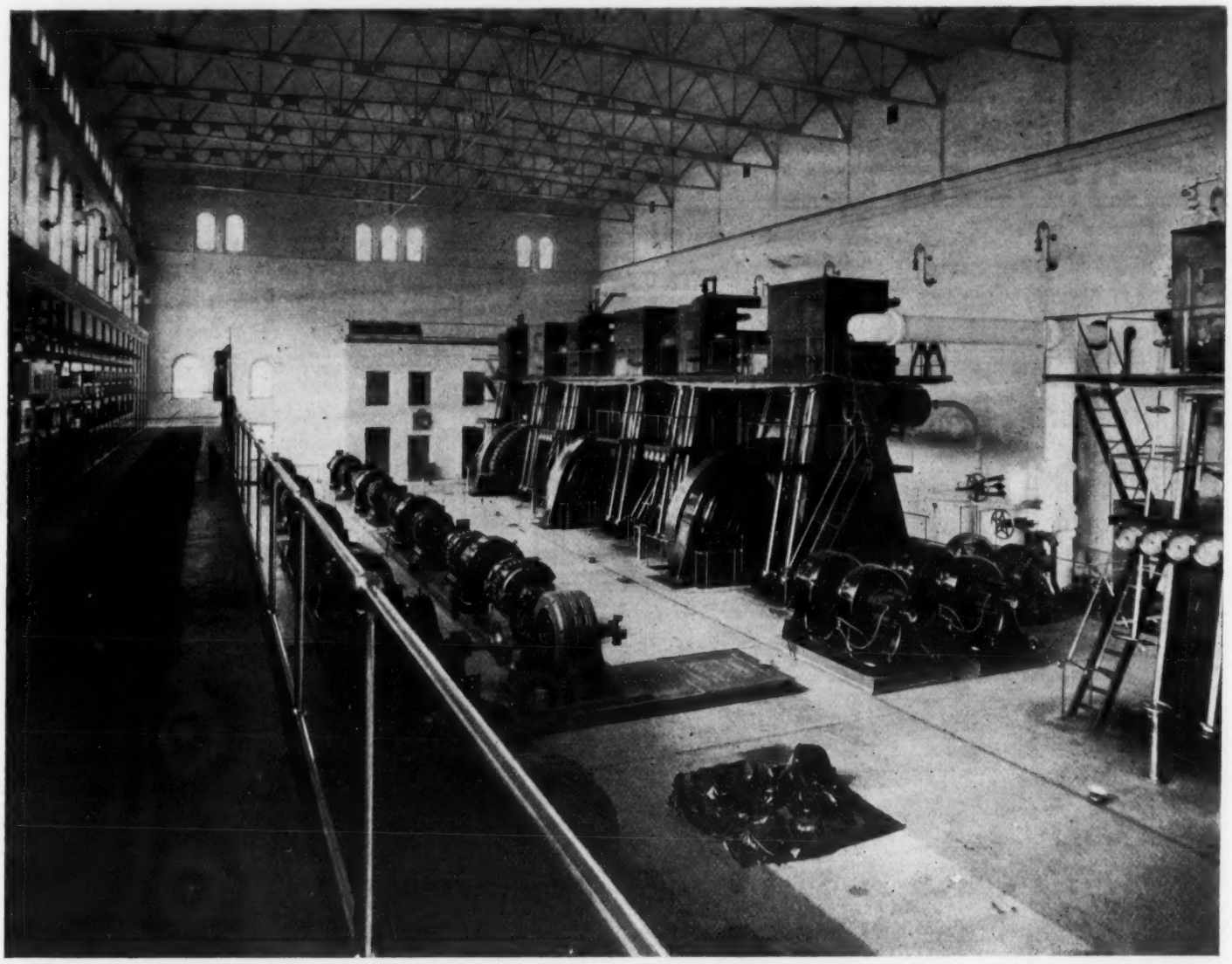


FIG. 1.—GENERAL VIEW OF OPERATING ROOM FROM SWITCHBOARD GALLERY.

white enameled bricks and the underside of the hollow tile roof is plastered with white cement. The windows are fitted with venetian glass which does not permit direct sunlight to pass through, but gives a diffused illumination. The engine room floor is of terrazzo mosaic, and all the machines are painted a dark maroon. The room is lighted by 32 enclosed arcs hung from the walls. All of the wiring to these as well as to the craneways, etc., are rubber-covered, and run through a conduit of hollow bricks imbedded in the walls at the proper locations.

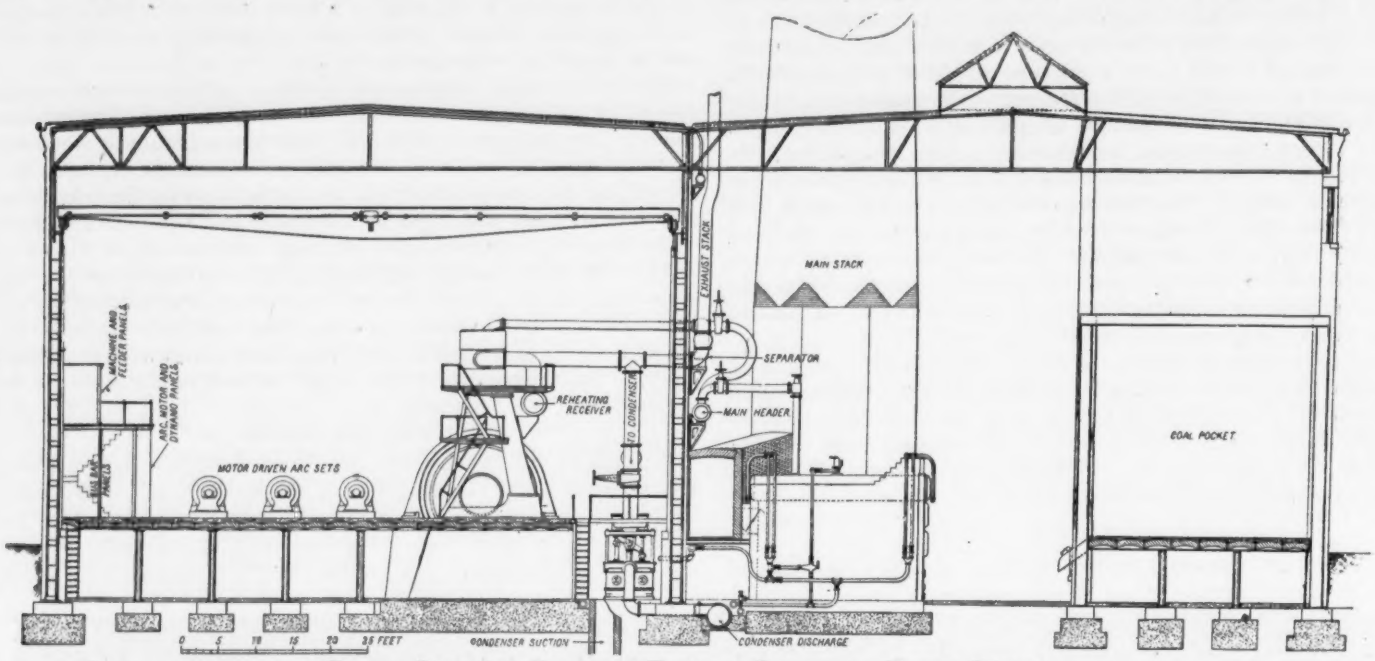


FIG. 2.—SECTIONAL ELEVATION THROUGH BOILER AND ENGINE ROOMS.

Four of the six generating sets are now in place. The engines are of the vertical cross-compound type with a rating, as before stated, of 2350-hp each, and run at 120 r. p. m. with a piston speed of 960 feet per minute. They are of the vertical marine type, each provided with a 50-ton 16-foot flywheel and shaft governor, operating cut-off valves in both the high and low-pressure cylinders. The valves are of the usual McIntosh & Seymour gridiron type running across the cylinder heads. The main journals are water-jacketed. The engines are guaranteed to give 2 per cent. regulation between no load and full load, and owing to the conditions due to parallel running of the alternators to which they are direct connected, they are also guaranteed to vary from uniformity not more than 0.1 of a degree throughout a stroke. The governors are fitted with a speed

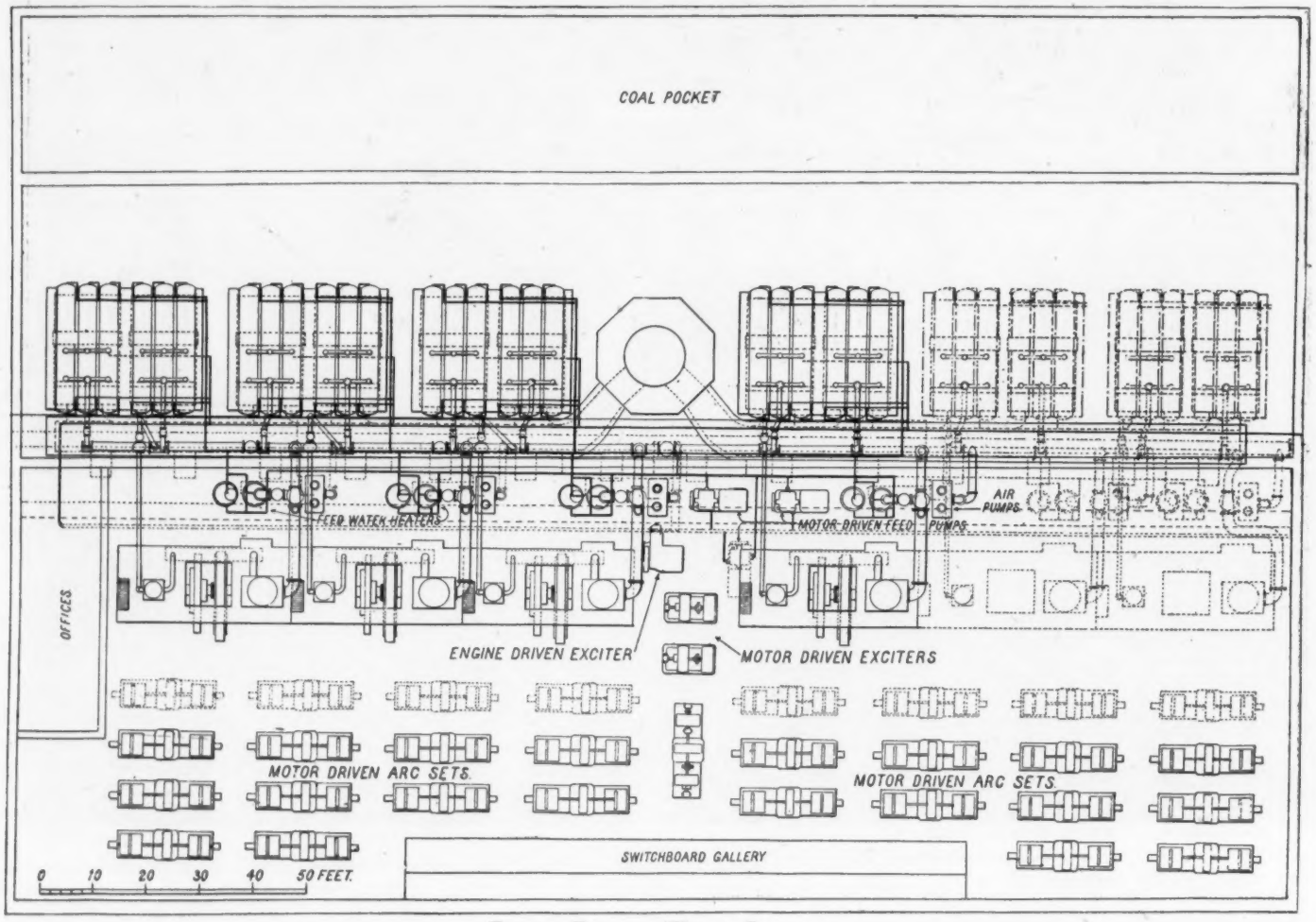


FIG. 3.—PLAN OF WHOLE STATION.

controlling device which may be set by hand to adjust the speed through a range of several per cent., thus enabling the speed to be controlled in the operation of synchronizing when throwing in parallel, or for varying the distribution of the load between the engines. This action is produced by changing while the engine is in operation the bending moment of a leaf of the governor spring by means of a slipping collar, friction wheel and screw device.

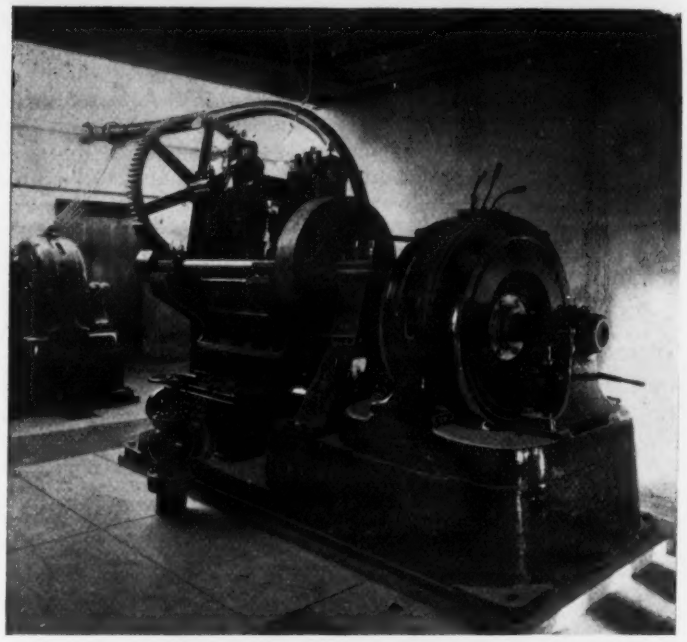


FIG. 4.—ONE OF THE MOTOR DRIVEN FEED PUMPS.

The engine exhaust passes through 24-inch pipes which run back into the boiler room and there combine in groups of three to an atmospheric riser for use when not running condensing. On the engine room side of the wall the exhaust pipe from each engine branches downwardly through a 24-inch gate valve operated by a motor, then through a surface heater to a jet condenser. The latter draw their water from the harbor and are discharged by Blake vertical twin air pumps. The boilers are fed through three Gould triplex pumps with a capacity of 200 gallons per minute; each is driven through triple-reduction gearing by a 30-hp G. E. induction motor (Fig. 4). The pumps are kept running at constant speed and the feed is controlled by hand-operated bypass valves. The feed water passes through the main exhaust heaters and then in series through auxiliary heaters, one for each engine, the latter taking the exhaust of the air pumps and other auxiliaries.

An extremely complete pneumatic lubricating system is provided. This consists of three 400-gallon pressure tanks in the basement below the dynamo room, two for engine and one for cylinder oil. An air pressure of about 20 pounds per square inch is kept upon these tanks by an air compressor driven by a motor, the compressor being also piped to hose connections for cleaning the machines, switchboard, etc., of dust. The air pressure forces oil into tanks on the engine platforms from which it is fed to the various lubricating points.

THE GENERATORS.

The dynamos are General Electric 60-cycle machines rated at 1500 kilowatts, with a regulation of 5 per cent. Their heating limit is, however, considerably higher, as they are guaranteed to carry a 30 per cent. overload for any length of time. They are of the revolving field type with 60 outwardly projecting poles having a diameter at the air gap of 16 feet. The field is wound with an edgewise strip. The external stationary armature has six slots per pole, containing a delta-connected three-phase winding generating 2250 volts. The coils are made up of braided conductors covered with a braided insulation and formed under pressure into a square cross section. This is saturated with an insulating compound and further insulated from the iron of the machine by tape and shellac.

From the machines the main conductors run to switches on the engine foundations by which the current can be sent to the switchboard through either one of two sets of machine leads. The one is rubber-covered and run in fibre ducts embedded in the concrete of the engine room floor, while the other is lead-covered and run in the ordinary vitrified conduit in the basement floor. These two paths are provided so that any burn-out of the station wiring shall not shut down the machines. Approaching the switchboard these two sets of leads are brought together through heavy knife switches by which either one or the other of them can be cut off at that end, and from the junction they pass through electro pneumatic main switches, breaking under oil, to a set of throw-over switches, by which any generator can be thrown on to either one or the other of the two sets of bus-bars.

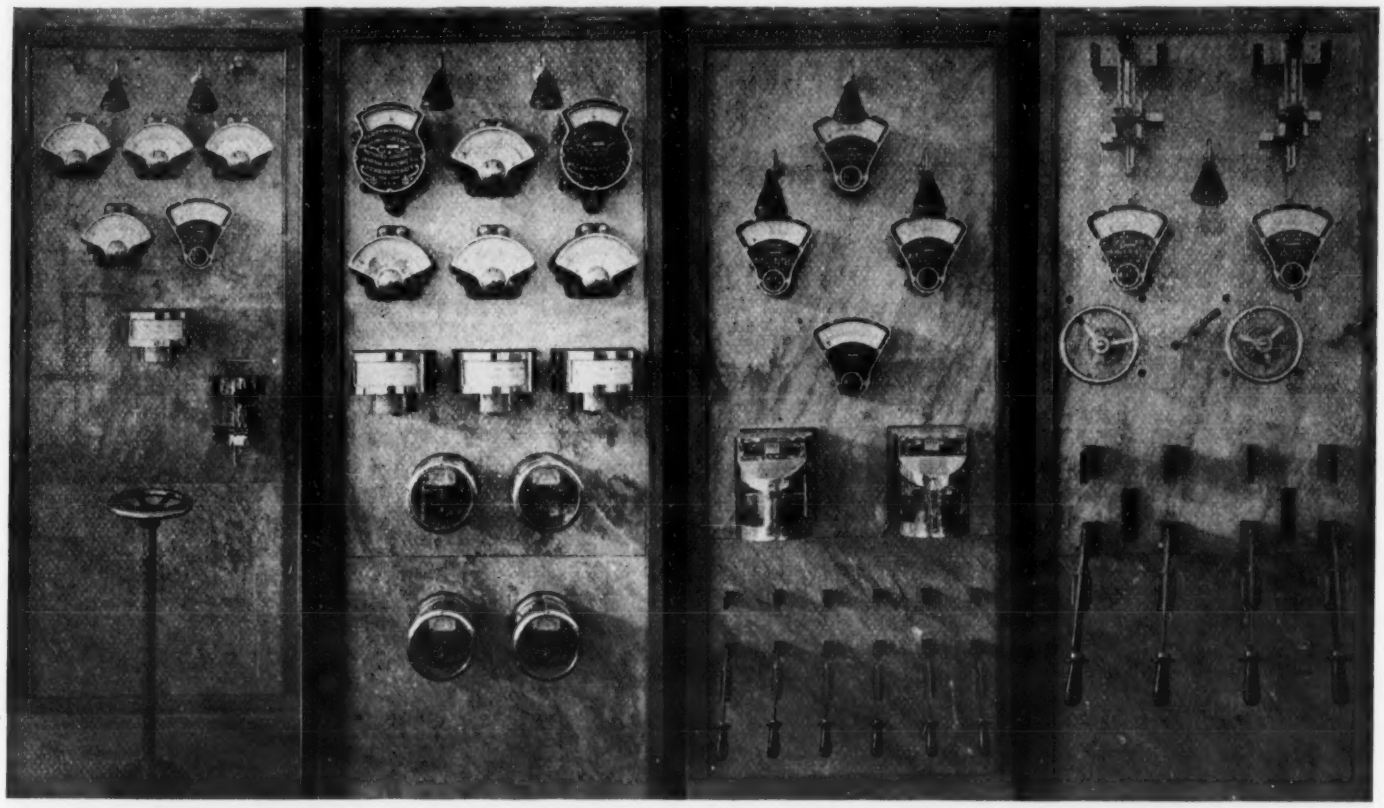


FIG. 5.—MAIN GENERATOR PANEL. FIG. 6.—BUS BAR TOTALITY PANEL. FIG. 7.—EXCITER TOTALITY PANEL. FIG. 8.—PANEL FOR TWO EXCITERS.

THE SWITCHBOARD.

The switchboard of this station is necessarily, owing to the extensive use of motor generators, one of the most elaborate thus far built, and comprises in its general scheme and construction many novel features and details. It is in all 115 ft. long and not only double decked, but the lower board is two tiers deep; that is to say, there is, in addition to the board which stands flush with the front edge of the gallery above, another switchboard below the gallery and behind the forward one. There are thus three boards, all of blue Vermont marble and mounted, not on steel but on glued-up oak frames. The upper board in the gallery contains the machine panels to which, by the way, no heavy currents or high tensions run, all instruments being worked by derived current, the main switches being handled by electro-pneumatic mechanism. Besides these panels are various other totality panels, exciter panels, 500-volt panels, etc., which, on account of their diversity and general novelty, will be described and illustrated in detail.

The main generator panels themselves, one of which is shown in Fig. 5, are equipped each with two pilot lamps and two synchronizing lamps, three alternating-current ammeters of the inclined coil type, one in each phase, one alternating-current voltmeter of the same type, and beside it one direct-current astatic ammeter in the field circuit. Below these instruments in the center of the panel is an indicating wattmeter, reading up to 2500-kw, and below this to one side is an Elden circuit breaker in the field circuit. The field rheostat is manipulated by a grip wheel mounted on a shaft rising through the floor in front of the panel. The face plate of the rheostat is on the ceiling immediately below the floor and is wired to resistances of the cast grid type.

is connected to receptacles on the exciter panels, to give comparative indications for paralleling. Below these four instruments are two Thomson integrating wattmeters, one on the fields of the generators and the other on those of the synchronous motors. The six switches at the bottom of the panel are each in one leg of the branch going to one of the generators, the other leg being closed through the circuit breaker mentioned above on the main generator panel. The field circuit of any machine is closed by first throwing in the breaker on its own panel and then throwing the corresponding switch in the group of six on the exciter totality panel. The breaker is fitted with a special catching device so that if there is no trouble and it does not come out when the switch is first thrown in, it may be locked by hand so that there cannot be any accidental opening of the field circuit while the generator is running on the load. The field circuits are opened by these breakers, and it is notable that there is no shunt to take the powerfully inductive discharge.

The next panels control the exciters of which two are connected to each panel. A view of one of these is shown in Fig. 8. The machines are compound wound and the equalizer is connected direct between them and does not run to the switchboard. The arrangement of the circuits through the other instruments of the panel possesses no unusual features.

Further to the right are panels controlling the 500-volt circuits, the first and second of which are shown in Fig. 9. That to the left in this illustration handles the incoming 500-volt power arriving at the board from two sources, one of which is the motor driven generator in the station and the other a rotary converter in a substation uptown, from which 500-volt feeders are carried back

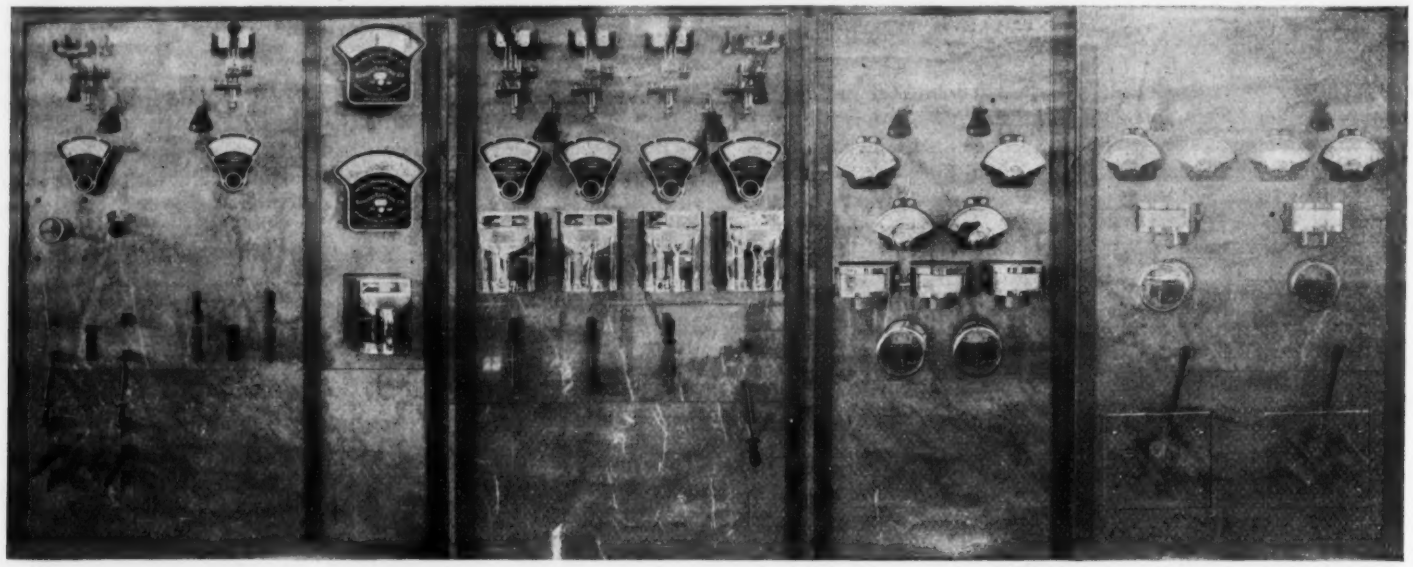


FIG. 9.—500-VOLT INCOMING AND TOTALITY PANEL.

FIG. 10.—500-VOLT OUTGOING FEEDER PANEL.

FIG. 11.—THREE-PHASE FEEDER PANEL.

FIG. 12.—LIGHTING FEEDER PANEL.

There are six of these panels—four of them equipped—at the left-hand end of the board as one faces it, and next to them to the right is the totality panel, measuring the combined output of the generators. The equipment of this is shown in Fig. 6, and it is remarkably compact and pleasing in appearance owing to the symmetrical arrangement of the instruments. At the top is a voltmeter flanked on either side by a ground detector and below these three instruments are 3 indicating ammeters, whose series transformers are mounted on the three main bus-bars. Below these are 3 indicating wattmeters, showing the power passing along the same buses, and below these again are four integrating wattmeters of the new induction motor type in ornamental cylindrical glass cases. Two of these register the energy passing over one set of buses and the other two over the other set of buses, each pair working on the well known 2-wattmeter method.

Next to this panel is one measuring the total output of the exciters, which is also shown separately in Fig. 7. Its equipment consists of two astatic voltmeters and two astatic wattmeters, neatly arranged in a diamond grouping. One of the ammeters measures the total output going to the generator fields and the other the total to the synchronous motors. One of the two voltmeters is permanently connected across the exciter bus-bars and the other to the generating station. On the sub base of this panel there will be seen two large and two small throw-over switches, whose purpose is to connect the motor-driven generator in the station either to the 500-volt bus-bars or to the lines running out to the motor of the coal conveying tower, which it runs on the Ward-Leonard system. This it does during the day-time while at night it supplies the 500-volt motor load over the 500-volt feeder mentioned above, the rotary up-town being shut down.

The next panel to the right, which is also shown in Fig. 9, is a 500-volt totality panel fitted with two voltmeters, one on the bus-bars and the other on the receptacles, and one integrating wattmeter which measures all the power given out by the motor driven 500-volt generator. Adjacent to this panel is one fitted for four outgoing 500-volt feeders, the instruments on which will be clear on inspection of Fig. 10. Their connection is self-evident.

Still further to the right are two panels for the duplicate outgoing three-phase power lines to the up-town rotaries. As will be seen by inspection of Fig. 11 each of these is fitted with four inclined coil instruments, three of which are ammeters—one in each leg—and one a voltmeter, also three indicating wattmeters and two integrating wattmeters, measuring the output on the two wattmeter mehod. These panels are to have oil break switches installed later.

The balance of the board in the gallery is filled with panels supplying the 14 lighting feeders which are all single-phase but so many in number that the load can be balanced without running out three-phase wiring. The equipment of these, which are fitted for two feeders each, is illustrated in Fig. 12, and consists per feeder of one ammeter, one indicating wattmeter, one voltmeter with Mershon compensator, one integrating wattmeter and one 20-kw C. R. potential regulator, with contacts handily arranged behind a glass plate on the sub base of the panel. These regulators embody some novel features in their construction. The handle rises vertically to a convenient height for manipulating it and operates the snap contacts through a ratchet with a reversible pawl for raising or lowering the voltage. The regulators can handle each 200 amperes up or down 5 per cent. or 100 amperes up or down 10 per cent., according to the connections of the series transformer. The switches make two complete rotations about the dial, automatically reversing the connections as they pass a neutral point where there is no boosting or lowering of the voltage. These panels also are to be fitted with oil break switches, which were not in place at the time the photograph was taken.

As mentioned above, there are downstairs really two switchboards, that in front and facing the station being devoted to the arc apparatus and its motors. Taking up the equipment of the latter first, a very novel and interesting feature to all who handle arc machines will be found in the arc panels shown in Fig. 13. These panels are designed for working without cords except for two rows of bushings across the bottom of the panels, to serve, as the illustration indicates, for transferring circuits from panel to panel. The panels are double decked and like the rest of the switchboard, made of blue Vermont marble in wooden frames. The equipment is very compact, the board rising only to a height of 7 ft. 6 ins., giving each panel only half that heighth, in which 16 circuits and 8 two circuit machines are handled. At the middle of the panels is an ingenious device for changing any machine at any time from a two circuit to a single circuit arrangement and consists of sleeves at different distances behind the panel into which either short or long plugs may be pushed from the front of the board. The plugs of the two different lengths have differently colored heads so that the condition of the circuits is always indicated. Across the lower part of the panel are transfer buses distinguished from the others by the color of the vitrified bushings which differs from the white porcelain of the machine bushings.

Another interesting novelty in arc work is the test panel which is shown in Fig. 14. It is fitted with a voltmeter, with a scale reading up to 10,000 volts and two Thomson arc ammeters. These ammeters are connected with bus-bars running the whole length of the arc panels, into which any machine can be plugged. The potential instruments are also connected with buses running to electro-magnetic relays behind the arc panels by which they may be connected across the terminals of any machine or circuit by pressing the proper one of the large number of push-buttons shown upon the test panel. At the top of this panel are also four pairs of sockets by which the voltmeter or magneto, or a 125-volt circuit may be connected for testing between the test board terminals, and thence via the electro-magnetic relays to any circuit or machine. The voltmeter is also fitted with ground plug by which grounds can be located in the usual way.

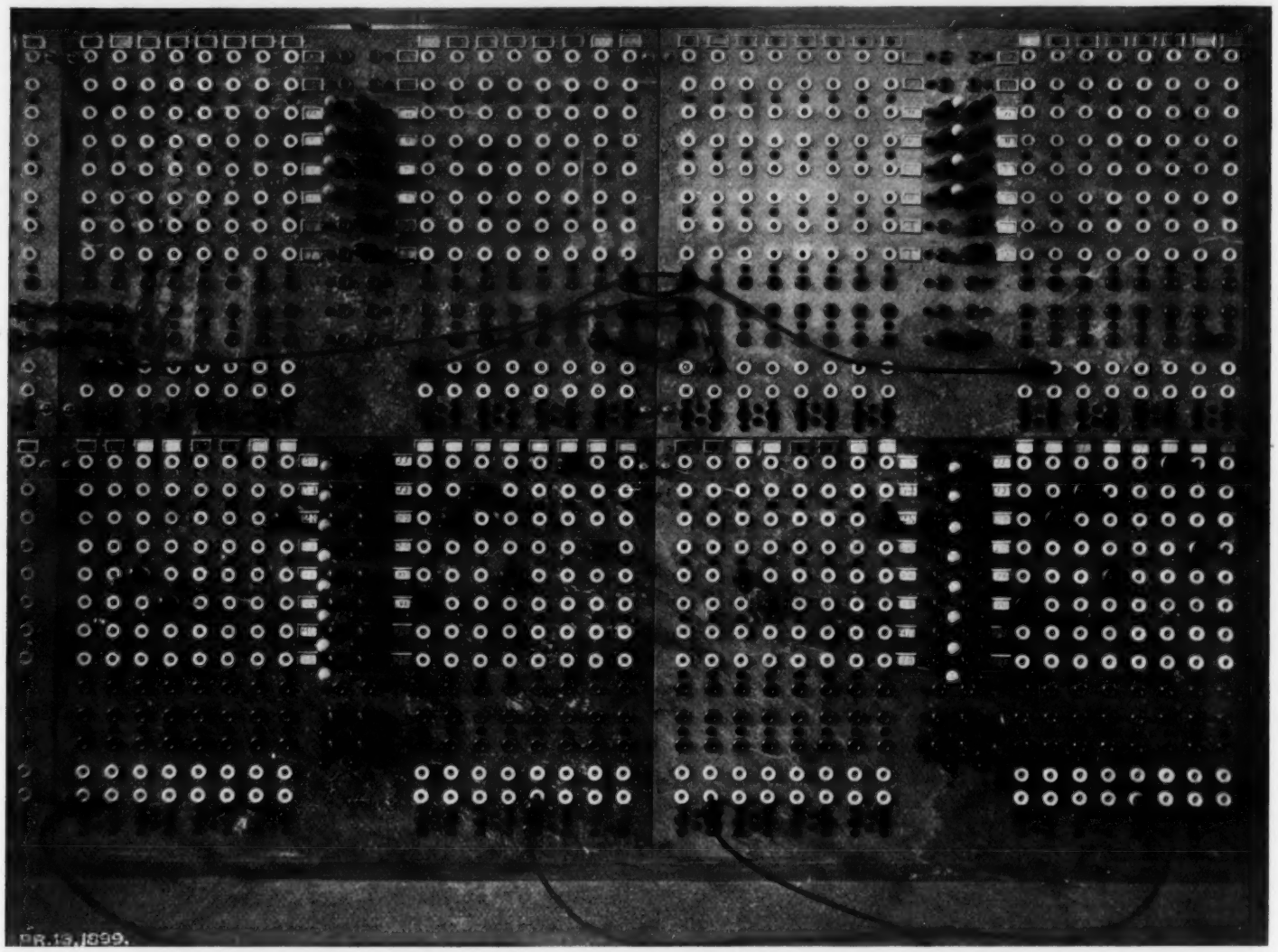


FIG. 13.—FOUR OF THE ARC LIGHT PANELS.

Beyond the arc switchboard are 16 panels carrying the instruments connected in the supply circuits of the synchronous motors driving arc and other dynamos on the floor of the operating room. The equipment of one of these panels, each of which supplies two motors, is shown in Fig. 15. The measuring instruments consist of a field ammeter, an alternating ammeter in one leg of the motor circuit and an integrating single-phase wattmeter calibrated to give the total wattage, its use being allowable on a three-phase motor circuit on the assumption that the load is balanced. The current controlling instruments consist of a rheostat, circuit breaker and switch in the field circuit. There are to be added later oil break

switches in the armature circuits which will be connected to throw over on to one group of compensating transformers to give to any motor a lower voltage when starting. These oil break switches will be only double pole, the third pole being an ordinary knife switch which can be pulled out without the possibility of arcing after the oil break switch has been opened.

Owing to the large number of motor meters and the fact that most of them are idle during the day the potential coil of each is connected through a switch by which it may be opened to economize current while the circuits fed through these meters are idle.

Another interesting detail is the use of only one set of potential transformers for supplying the Y boxes of all of these integrating wattmeters, i. e., instead of putting in potential transformers for each meter there is only one set for the whole battery.

tween the machines is covered with a cork matting which prevents any risk of shock in case of grounded circuits. Besides these 20 arc sets is another similar synchronous motor, coupled at one end to the 500-volt generator mentioned above and at its other end to a two-phase alternator designed for use on grounded feeders to isolate them from the main system, any ground on such an extensive network of alternating lines being liable to develop a bad burn-out owing to the very high capacity between the conductors and ground and the consequent volume of the charging current. Two other synchronous motors are direct coupled to 75-kw, 25-volt exciters, besides which there is another 50-kw exciter, direct coupled to an Ames engine.

The main features of the station were laid out by President F. A. Gilbert and Assistant General Manager Sidney Hosmer and many

FIG. 14.—ARC TEST PANEL.

FIG. 15.—SYNCHRONOUS MOTOR PANEL.

Running the whole length of the passage way beyond the arc and motor board and under the gallery are what might be termed "bus-bar panels" carrying the main conductors of the three-phase generators. Another very interesting peculiarity of this switchboard is the fact that the bus-bars, as well as a good many other conductors about the board, are made of aluminum, which was chosen largely to save weight. There are two sets of three-phase bus-bars running the whole length of this rear board, the cross section of each of the three bars of one set being 1 x 5 ins. and of the other set 2 x 5 ins., the latter being that regularly used.

The various panels contain the switches by which the main dynamos, motors and feeders can be changed over from one set of bus-bars to the other and these switches are ingeniously arranged with two independent knives to each pole so that one knife can be thrown up and the other thrown down simultaneously, connecting the feeder or machine across the two sets of bus-bars in parallel. In this way any circuit can be changed over from one set of buses to the other without for an instant interrupting the continuity of the current supplied to it, a great feature where such large currents are handled, the breaking of which causes serious arcing.

THE ARC MACHINES.

The arc dynamos are Brush two-circuit machines, coupled in pairs to 200-hp synchronous G. E. motors. The arc dynamos have the new oil regulator and are with the motors mounted on oak bases, giving them insulation from ground. The mosaic floor be-

of the original features of the switchboard are the personal work of Mr. L. L. Elden.

Electricity as She is Taught.

Any one who wishes to discover how badly scientific facts and statesments can be distorted and misrepresented may be accommodated by glancing through the pages of a recently published "Catechism" which purports to be a "compendium of practical knowledge in every branch of mechanical industry." Its title page also states that water, steam, fire, smoke, electricity, horse?power and some fifty other classifications of engineering are treated—how badly treated may be judged from the following examples of definitions in the electrical section: "Automobile—Machines that move automatically through electricity or any other force." "Horse-power—To find the power of engine required to run a dynamo, multiply voltage by amperes, then multiply the answer by number of lights lit and divide by 746. Answer in Watts." "What is a transformer? It is used for tapping a low voltage circuit into a high voltage circuit, as in connecting an incandescent lamp to an arc light circuit." "On what principle are transformers based? On greater or lesser resistance." "What voltage and horse-power are the motors of elevated roads? Generally 2000-volt type and 100-hp." "How many are usually placed on a car? One at each end of the car, so as to avoid the need of a turntable."

Mechanical Stresses on Dynamo Coils.

BY P. M. HELDT.

WHEN dynamos with slotted armatures were first placed upon the market, one feature about them which served as an excellent talking joint, is the driving action of the teeth. With smooth core armatures the slipping of the armature conductors had to be prevented by driving horns or pegs, which were generally of hard fibre in smaller machines, and of hard wood in larger ones. There was no need for these driving horns in the slotted armature, as the teeth take their place. With teeth in one piece with the armature core, and the conductors fitted tightly between them, there is no danger of the latter being dislodged, even in case of a short circuit.

Later on it was found that in slot-wound armatures practically all of the armature torque comes directly on the teeth, and but little of it on the armature conductors. It is not known to the writer who was the first to observe this unexpected and interesting fact, but among the first to mention it in their writings may be mentioned Prof. Silvanus P. Thompson and Messrs. Houston and Kennelly.

At first thought the reason for this difference in the action on the conductors of a smooth core and slotted armature is not at all apparent, and it is therefore but natural that the announcement of this fact should have been met with protests and scepticism. For instance, a writer in commenting on an article by Messrs. Houston and Kennelly, who investigated a certain phase of the subject, stated that, had the experiments been made on an armature in motion instead of on an armature at rest, the results would have been the reverse; and in a review of the German translation of Prof. Thompson's work on polyphase currents, the reviewer called the translator to task for not having corrected Prof. Thompson's statement that in armatures with pierced cores nearly all of the torque comes on the iron of the armature.

Today it is no longer a question that the force in dynamos with slotted or pierced armature cores is mainly between iron and iron, as theory has been shown to require it, and a number of experiments conducted by electricians of note have verified it. The theoritical explanation of the phenomenon is not, however, generally understood, and it is the object of the present article to give a proof of the subject in general, and to investigate a few special cases.

We assume an armature with slotted core, having a length l. The circumferential force on the armature divided by the number of conductors under the pole faces, will be referred to as the armature torque per conductor. Let the mean intensity of the magnetic field in the gap be $\mathfrak{H}$, and the current carried by any conductor I; then the armature torque per conductor is $F = c\, l\, \mathfrak{H}\, I$. (1).

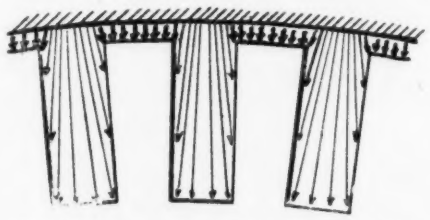


FIG. 1.—DISTRIBUTION OF MAGNETISM IN THE SLOTS AND GAP.

With the proportions usual in modern designs, practically all of the magnetic flux passes through the teeth, and but little through the slots. The intensity of magnetization is therefore much less in the slots than in the gap. The mean intensity of magnetization in the slots may be denoted by $n\,\mathfrak{H}$, where n is a small fractional coefficient. The interaction of the magnetic field in the slot with the current in the conductor produces an infinitesimal displacement of the latter with regard to the core. We will call this displacement dx. The electrical energy produced by this motion of a conductor, carrying a current in a magnetic field, is equal to the mechanical energy required to produce this displacement.

$$F_2\, \delta\, x = c\, I\, (n\, \mathfrak{H})\, l\, d\, x.$$

As the force acts through a distance dx, its value is $c\, n\, l\, \mathfrak{H}\, I$. This is the actual force or drag on the conductor. Comparing this value to the value of the torque per conductor, found in equation (1), we see, the actual ratio of the former to the latter is n—the ratio of the magnetic intensity in the slots to the magnetic intensity in the gap.

The magnetic intensity in the slots is not uniform. The diagram, Fig. 1 illustrates the distribution of magnetism in the slots and in the gap. It will be noticed that the density is greatest near the outer edges of the teeth, and decreases towards the centre and bottom of the slot. Let l be the length of core, w the mean width of tooth, d its depth, $\mathfrak{B}$ the mean induction density in the tooth and a the length of air gap. The faces of the field poles and the cylindrical shell to which the bottoms of the slots form tangent planes, are surfaces of equal magnetic potential. The reluctance of the tooth is $\frac{d}{w\, l\, \mu}$ and the reluctance of that part of the gap through which the magnetism of this tooth passes is $\frac{a}{1.2\, w\, l}$. In this expression the numerical coefficient $\frac{1}{1.2}$ represents an allowance for the increased width of the tooth at its face, and the fringing of the magnetic lines. These two reluctances are in series, and may therefore be added together.

$$\mathfrak{R} = \frac{d}{w\, l\, \mu} + \frac{a}{1.2\, w\, l.}$$

The magnetic flux passing through this reluctance is $w\, l\, \mathfrak{B}$, and the

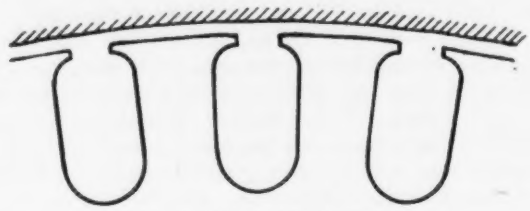


FIG. 2.—OVERLAPPING TEETH.

difference of magnetic potential between the two surfaces is therefore

$$\mathfrak{B}\left(\frac{d}{u} + \frac{a}{1.2}\right)$$

As stated above, the magnetic intensity in the slot is not at all uniform, but the mean value of the component parallel with the faces of the slot is uniform, supposing the slot to have a rectangular crossection. Now let us take a part of the magnetic path between these two surfaces, in the form of a prism, with bases of unit area, and having its longitudinal edges parallel with the sides of the slot. The magnetic reluctance of this prism between its two end faces is $d + a$. The mean intensity of the magnetic component parallel with the sides of the prism is

$$\left(\frac{\frac{d}{\mu} + \frac{a}{1.2}}{d + a}\right)\mathfrak{B}.$$

This coefficient, $\frac{\frac{d}{\mu} + \frac{a}{1.2}}{d + a}$ represents the ratio of the mean magnetic intensity in the slot, along a line perpendicular to the bottom of the slot, to the mean induction density in the teeth. We will denote this ratio by v.

Let w, and w_2 represent the width of the tooth at the surface of the armature and the width of the slot respectively. Then the ratio of the mean magnetic intensity in the slot to the mean magnetic intensity in the gap is $\frac{(w_1 + w_2)\, v}{w + w_2\, v}$.

This is, as stated above, the ratio of the actual force on any conductor to the armature torque per conductor. In studying this expression it will be noticed that it increases in value as w_2 increases and w and w (which are dependent on each other), decrease. In the limiting case when w and w, are zero (smooth core armature), the value of the expression becomes unity, indicating that in a smooth core armature the full force comes on the conductors. It will thus be seen that if the teeth are narrow, and the slots wide and of small depth, the conditions approach those in a smooth core armature; whereas the shielding action of the teeth is much greater when the slots are deep and narrow as compared with the teeth. To get an idea of the relative force on the conductors in modern slot wound armatures, we will assign the following values to the dimensions of the core in Fig. 1,

$d = 1$ in.; $a = \frac{1}{16}$ in.; $w_2 = \frac{3}{8}$ in.; $w_1 = \frac{13}{32}$ in.; $w = \frac{3}{8}$ in. Let $\mathfrak{B} = 110{,}000$, then $\mu = 150$ approximately. These figures give v, the ratio between magnetic density in slot to magnetic induction in teeth, the value .055. The ratio of the force on each conductor to the armature torque per conductor becomes .109 or about 11 per cent.

When the teeth have an overlapping form, as shown in Fig. 2,

there is still less stress on the conductors, other things being equal. The teeth presenting more surface to the passage of the flux across the gap, there is a smaller difference of magnetic potential between the polar surface and the bottom of the teeth. Besides, the slots are nearly closed on top, and very few lines will go directly from polar surfaces through the slot. It was with an armature with teeth of an overlapping form that Mordey made his experiments on the force on armature conductors. The machine was an alternator with stationary external armature. One coil was removed from the armature, and a copper strip was placed in one slot, wedged tight between wood blocks at one end, and connected by flexible conductors at the other end in series with four coils of the armature. The loose end had a pointer attached, which moved over a graduated scale. The machine was run with field exited, and when a certain current was flowing through the armature, the deflection was noted. The same deflection was then produced by a weight, and it was found that this weight was only one-tenth of the force on the armature divided by the number of conductors.

The drag on the conductors is less in pierced cores than in either of the above two types, as the magnetic shielding is here the most complete. Prof. H. du Bois has investigated this case, and finds that the magnetic density in the gap bears to the magnetic density in the holes a ratio which tends towards the limit $\frac{1}{4}(\mu-2)+1$, as the distance between the edge of the holes and the surface of the armature is increased. With a density of 100,000 lines per square inch, this gives for the force on the conductor about 1 per cent. of the armature force per conductor, which is about the lowest value that could be obtained in a practical machine. The little experimental machine built by Messrs. Houston and Kennelly had a pierced core, and the result of the experiments was that the force on the armature conductors amounted to 1.4 per cent., while the force on the core teeth was 98.6 per cent. of the total. The division of the torque between armature conductors and core teeth depends on the

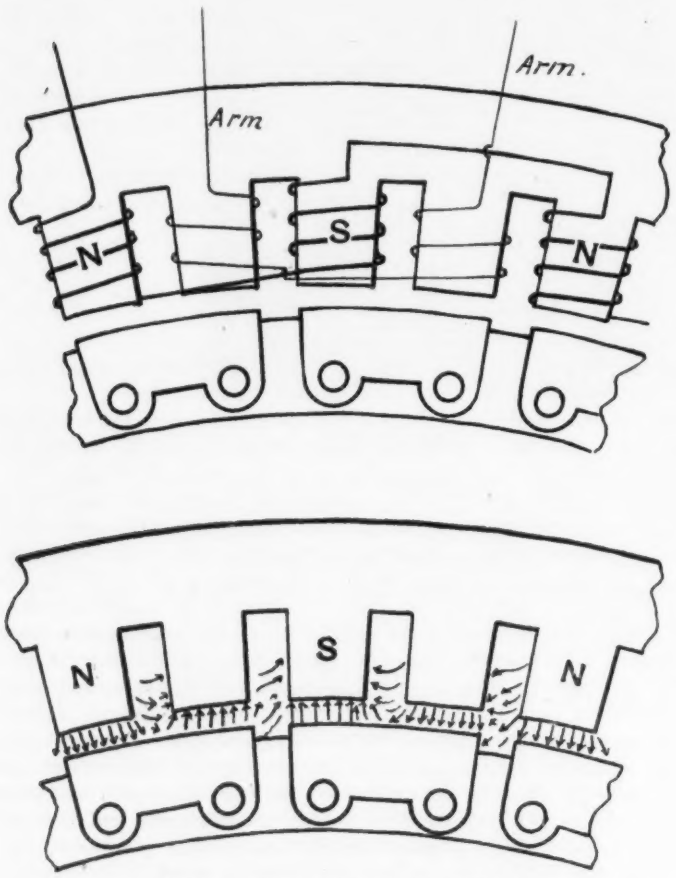


FIG. 3.—INTER-FLOW OF MAGNETISM.

dimensions of the teeth, slots and gap only, and is not affected by the form of current the machine furnishes. Direct and alternating current dynamos are thus alike in this respect, provided their construction is the same.

Inductor alternators present a case of special interest as regards the distribution of the armature torque, as both the exciting and the armature winding are disposed on the stationary part of the machine. As an example we may take an alternator of the Kingdon type, in which the field and armature coils are wound on alternate poles of an external stationary ring. Masses of laminated iron, bolted to an internal rotating wheel, produce a rapid periodic reversal of magnetism through the poles on which the armature coils are wound, and thus generate an e. m. f. in these coils. Fig. 3 shows the flow of magnetism in the spaces between the poles, for a certain relative position of the stationary and movable members of the machine. The flow of magnetism is here crosswise instead of lengthwise, as in the slots of ordinary machines. It will be noticed that in the spaces adjacent to direction of the magnetic lines is opposed,

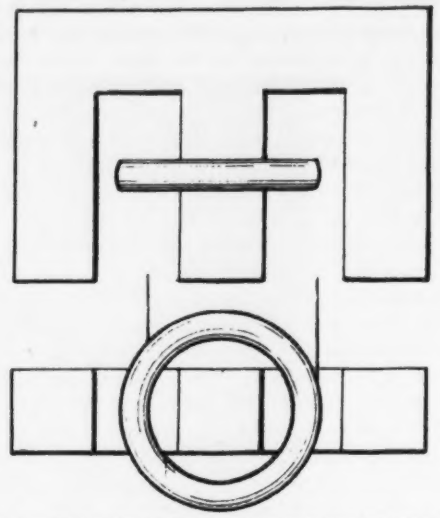


FIG. 4.—IRON CORE WITH THREE PROJECTING POLES.

while in spaces adjacent to armature poles the direction of the lines is the same. There is a force on the field coil tending to move it radially outward. The action here follows the law that a magnetizing coil has a tendency to move to a position, which corresponds to a path of least magnetic reluctance. For instance, a coil surrounding a long straight core has a tendency to move towards the centre of the core. That there is an outward radial force on the field coil in this type of inductor alternator is easily proved by an experiment. Fig. 4 shows an iron core with three projecting poles. If a coil of fine wire is suspended flexibly, so as to loosely surround the centre pole, and a strong current from a storage battery or other source sent throughout it, the coil will move towards the bottom of the slots between the poles. An armature, placed at some distance from the poles, will reduce the force on the coils.

The direction of the magnetic lines is the same in the spaces adjoining an armature pole, and as the current flows in opposite directions on the two sides, the direction of the forces on the conductors must be opposite on opposite sides of the pole. The magnetism in the spaces between poles does not reverse, and the force on the armature coils reverses therefore with the armature current.

As the forces on field and armature coils are both radial it is apparent that they are not part of the reaction between the stationary and rotary member of the machine, but must be looked upon as secondary effects of field and armature currents.

In machines of the ordinary type, the flux passing through the slots forms part of the useful magnetic flux, while in machines of the inductor type the flux in the spaces, occupied by the coils is waste or leakage flux. For this reason the magnitude of the mechanical stresses on the coils of an inductor alternator, of good design, are always small as compared with the turning effort on the circumference of the rotating part.

The Kansas Telegraph Suits.

Reference was made in these columns recently to the institution of several suits in Kansas against the Western Union Telegraph Company for alleged violation of the new telegraph rate law. District Judge Hazen, at Topeka, May 8, decided that the multiplicity of suits brought against the company was vexatious and oppressive, and that the telegraph company had a cause of action in applying for an injunction. Five hundred and forty-two damage cases have been filed before one justice of the peace. Judge Hazen said it would take three years to try all of them.

Electrical Radiation—III.

By ARTHUR V. ABBOTT, C. E.

THE great discovery of Hertz rendered it possible to transmit electrically, intelligible signals between two points, with no intervening connection, save that of the luminiferous ether, but the receiving apparatus used consisting of syntonized wire circuits, was of so insensitive a character that it was possible only to detect such pulsations over a very limited distance. Something infinitely more delicate was wanted, a kind of electric eye that could peer into space and detect the ripples in the ether, as the ordinary eye perceives the undulations on the surface of a pond. A number of investigators had already noticed that when an electric spark passed between two pieces of metal in close proximity, the pieces frequently adhered to each other. The serrated plates of lightning arresters are found thus united, and the contacts of telegraph relays frequently stick, if too finely adjusted. This action has been explained upon the hypothesis, that the heat of the spark was sufficient to weld the terminals, notwithstanding that the adhesion had been observed with masses so large and sparks so small as to render this explanation highly improbable.

In 1891 Professor Branley, of Paris, observed, while experimenting with fine metallic powders, that no matter how good a conductor a metal might be in bulk, if finely commuted its resistance was something enormous. He also found that if an electric spark took place in the vicinity of the filings, the resistance of the powder was suddenly and markedly decreased. Curiously, also if the metallic particles were jarred, or disturbed in the slightest, the original high resistance returned. Branley's apparatus is simple in the extreme. A small tube of glass, or other insulator, Fig. 4, is provided with caps through which small threaded rods or wires are inserted, the terminals of which are enlarged to fit the tube. By means of the screw thread, the ends of the rods may be adjusted at any desired distances from each other—usually from a sixteenth to a quarter of an inch—while the intervening space is filled with metallic particles. If now, a battery and galvanometer be connected to the terminals, the resistance of the filings is so great that no sensible current passes, and the galvanometer needle remains at zero. But let a spark take place in the neighborhood and immediately a large deflection shows that a great change has taken place in the electrical characteristics of the filings.

With the syntonized Hertzian circuits a minute spark was obtained across the terminals of the receiver whenever the coil discharged and the operation of the Branley tube probably depends on

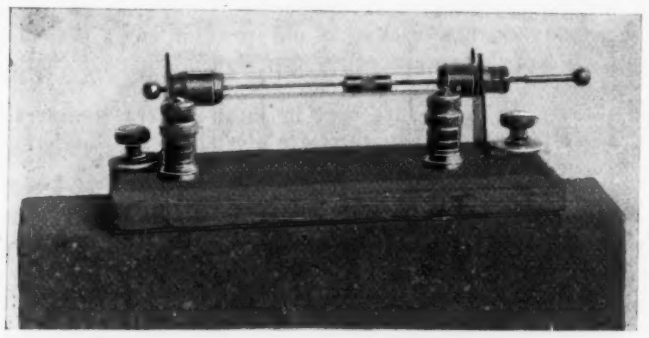


FIG. 4.—COHERER.

similar action. In its original state, each individual filing is not in electrical contact with its neighbor, but is separated from all other particles by a microscopic distance—possibly an air gap or, perhaps, a film of oxide. But electrical radiation can excite a considerable difference of potential, sufficient to cause minute sparks to jump between the filings, precisely after the fashion of the Hertzian receiver. These sparks break down the resistance of the filings and permit the battery current to be established. The action of the original sparks also weld the filings in a continuous connecting chain, having a certain amount of mechanical stability, so that even if the battery current is not applied until some considerable time after the instrument has been subjected to electric radiation, or no matter how frequent or prolonged may be the interruption of the battery current, the conductance of the filings remains unchanged until the tube is subjected to sufficient mechanical disturbance to destroy the conducting chains. An idea of the relation of the particles of the filings to each other, may be obtained from Fig. 5, which is a magnified representation of the Branley apparatus. From the welding action thus described, Dr. Lodge has termed this instrument a *Coherer* suggesting as explanation that the electric wave undulating through the metallic particles washes the atoms about in much the same fashion that one notes a sea wave sport with the loose sand of the beach, and returning leave a firm and compact surface that will hardly reveal the trace of a loaded wagon wheel.

In many respects the coherer strongly resembles the microphone. In both instruments a bad contact ordinarily regarded as a nuisance, is the foundation of sensitiveness. In the microphone, the mechanical action of a *sound* wave decreases contact resistance and permits

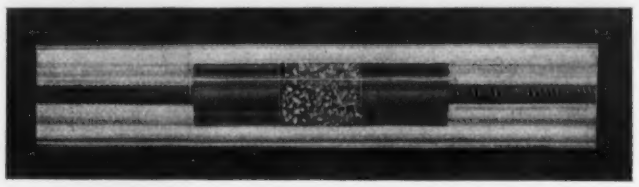


FIG. 5.—COHERER MAGNIFIED.

an auxiliary battery current to amplify the vibrations into audible limits. In the coherer the mechanical action of an *electric* wave permits an auxiliary battery current to operate any electromagnetic mechanism and repeat the exciting pulsations. There is little mystery in the manufacture of coherers, for almost anything will serve as a cohering material and any mechanical arrangement of bad contacts will suffice. A metal spring separated from a plate by an infinitesimal air gap exhibits this action. Two knobs separated by placing between them the finest cleaving of mica work splendidly. The only advantage of the filings is a mechanical one in that they most completely secure a very large number of bad contacts, readjusted with the least possible inconvenience. Nor is the substance employed for commutation so important as the mechanical treatment which it receives. A metallic powder is not essential, for carbon or selenium make good coherers and it is probable that any substance having reasonable conductance in the solid and possessing such physical properties as to permit it to be crushed into sharp angular fragments would operate.

To obtain the best results, however, there is some choice. Gold, platinum and the metals which are least oxidizable and are the best conductors, show the greatest sensitiveness; are most constant in returning to original adjustment; but are the most difficult to decohere. Silver may be included in this category. Nickel, copper and iron are much less sensitive to cohering action. They oxidize readily when finely commuted, and so do not retain the sensitive state, but they decohere promptly and are excellent materials for rough experimental work. Lead, zinc and other similar metals are so easily tarnished as to be almost unsuitable. The metal aluminum presents a peculiar combination of desirable qualities. Its low specific gravity largely decreases the effect of gravitation and enhances bad contact action. It does not readily oxidize, it is somewhat brittle and may be readily torn into jagged particles. Low conductivity is, perhaps, its only objection. Alloys and mixtures of metals without number have been tried, each experimenter having his particular pet formula for coherer construction. The Marconi apparatus consists of a mixture of 96 per cent. nickel filings with 4 per cent. of silver, while the ends of the electrodes are smeared with mercury. With some apparent advantages the filings have been placed in a vacuum, and tubes used filled with hydrogen, nitrogen or carbon dioxide, with a view to increasing permanence by preventing oxidization.

Some precautions are desirable in the preparation of coherer filing. The metal used and all tools should be carefully made chemically clean, and free from all oxide or scale. To get sharp, angular filing, a very coarse file, or preferably a wood rasp or triangular planing tool may be employed. This should be new and can only be used for the production of a limited quantity of filings, for as soon as the teeth are the least worn there is a tendency to make rounded spherical particles that are insensitive. The filing should be done with a quick jerky motion, as if the intention were to tear the metal explosively into shreds. The filings should be received on clean paper, quickly transferred to a tight bottle with as little exposure to the air as possible. Finally, they should be carefully sized by sifting. For the most sensitive instruments the filings that pass a sieve of 10,000 meshes per square inch and are rejected by one of 6400

the smaller is the liability to "packing." The ideal coherer should possess a maximum of sensitiveness. It should readily decohere and should remain constant in adjustment, but as these qualities are mutually antagonistic, almost any desired balance may be obtained by proper arrangement.

First—*Sensitiveness* is increased by improving the conductivity of the metal employed for the filings; by increasing the pressure upon them; by increasing their angularity; by increasing the uniformity in size between the particles; by reducing the actual volume of the filings employed; by decreasing the specific gravity; by removing chemical action; and by reducing the size of the individual filing.

Second—*Decoherence* is improved by the converse of all the preceding qualifications.

Third—*Permanence* is improved by increasing the size of the individual particles; by the use of a non-oxidizible metal; by immersion in an inert atmosphere; by careful sizing of the filings; by reduction in angularity, and by protection from excessive currents.

After an electric current has impigned upon the coherer, the instrument has lost its sensitiveness, and will no longer respond to additional stimulii, until restored to its original condition, by breaking the welds between the various particles. This may be readily accomplished by any method which will deliver a slight shock to the containing tube. The simplest plan is to tap the tube with a pencil, but as this is tiresome to the operator, an automatic hammer may be substituted. A simple and effective method consists in mounting the coherer on a springboard, which may be jiggled by any convenient motor such as a vibrating bell. In another admirable device the coherer is placed so that it may be rotated, either around its own axis or tilted end over end. By either method the filings are most thoroughly shaken up, and the apparatus may be noiseless, a decided advantage over any of the tapping methods. Whatsoever plan for decoherence is adopted, it is desirable that the disturbance of the filings should be as constant and as thorough as possible, and delivered regularly with such frequency as to always keep the metallic particles in the most sensitive condition.

Electrical Notes From Japan—II.

BY PROFESSOR F. B. CROCKER.

THE telephone in Japan, like the telegraph, is well established and widely used, being operated by the imperial government, as already stated. The important cities have large exchanges, and many of the suburban and smaller towns are provided with telephonic service. Until within a few months this was largely local, however, there being little or nothing to correspond to our vast system of long-distance" communication in the United States. While I was in Japan (Nov. and Dec., 1898) successful experiments were made in talking from Tokyo to Kyoto, a distance of 330 miles, and it is likely that this will result in an extensive development of long distance service. The conditions are favorable, since the principal places, Tokyo, Yokohama, Nagoya, Kyoto, Osaka and Kobe, lie in a nearly straight line, only about 375 miles long, and Nagasaki, the most distant city, is only about 800 miles, following the railway, from Tokyo. It would be a simple matter to telephone between any two of these Japanese centres, whereas it is not yet possible to reach more than about half way across the American continent.

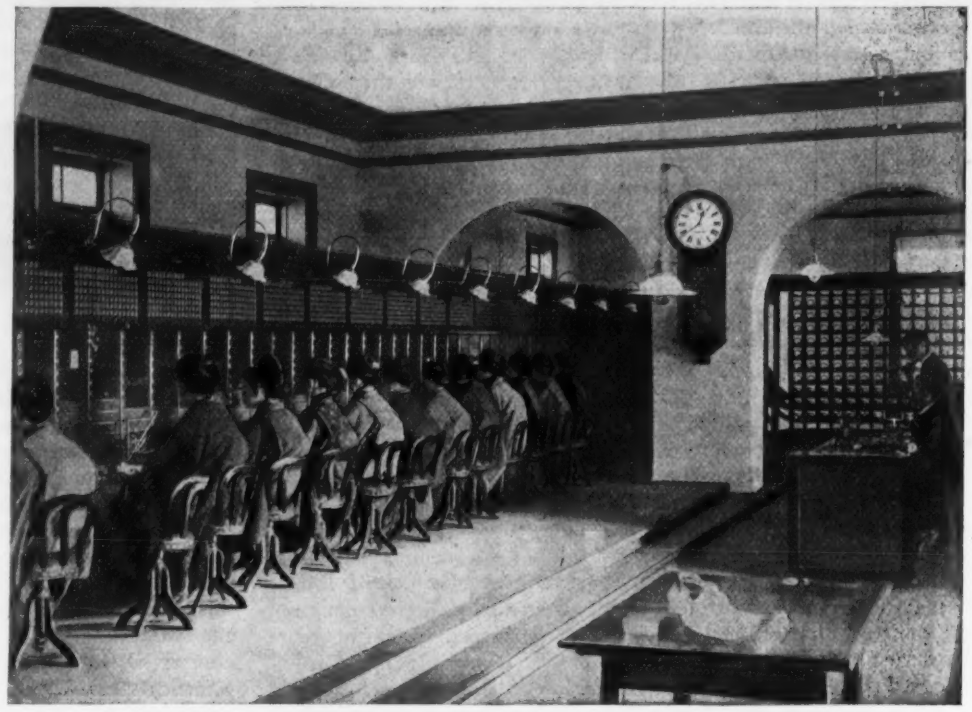


FIG. 3.—SHIMBASHI EXCHANGE, TOKYO.

The telephonic apparatus and methods employed in Japan are similar to those used in the United States, in fact two of the most important exchanges—the main station and the Shimbashi substation (Figs. 3 and 6) at Tokyo, have just been provided with the very latest American equipment by the Western Electric Company. It was like meeting an old friend, in fact a near blood relative, to find there some of my own dynamotors, for charging storage batteries, ringing calls, etc.

The number of telephones used in Japan is very considerable, particularly in Tokyo, where there are now about 4000 subscribers.

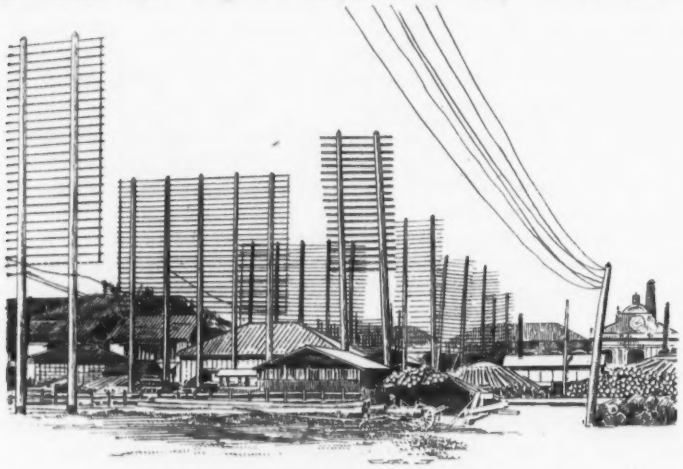


FIG. 2.—TELEPHONE WIRES, TOKYO.

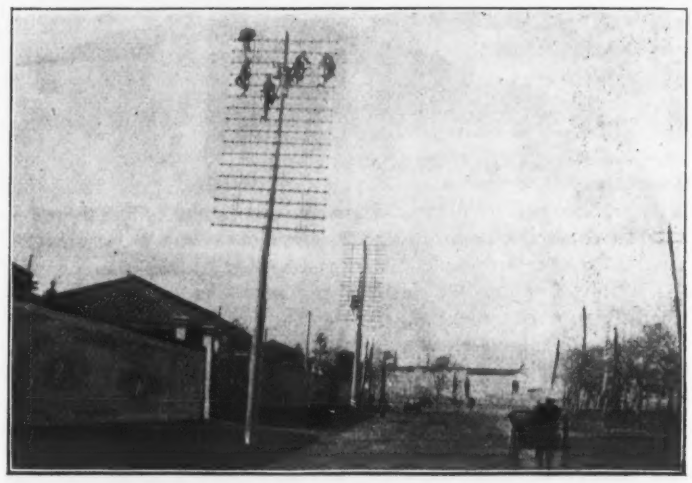


FIG. 4.—REPAIRING TELEPHONE LINES, KYOTO.

These will be increased to 5500 by the end of the present fiscal year. The central exchange alone is designed for an ultimate capacity of 6000. Demand for the service is greater than the present

facilities, but being a legislative matter it requires time to provide for the increase in business. The rental charged subscribers is $30 (United States gold equivalent) per annum, which, like the telegraph rates, is very low, especially for a great city of 1,500,000 inhabitants. Wires are almost entirely overhead, except in the case of trunk lines between stations, for which purpose underground cables are employed. It would be difficult to find any place in the world where aerial electrical conductors are more in evidence than in certain parts of Tokyo. This fact is forcibly illustrated in the accompanying illustrations. Some of the overhead construction is good, but much of it is bad. This applies to telegraph, telephone, electric light and electric railway lines.

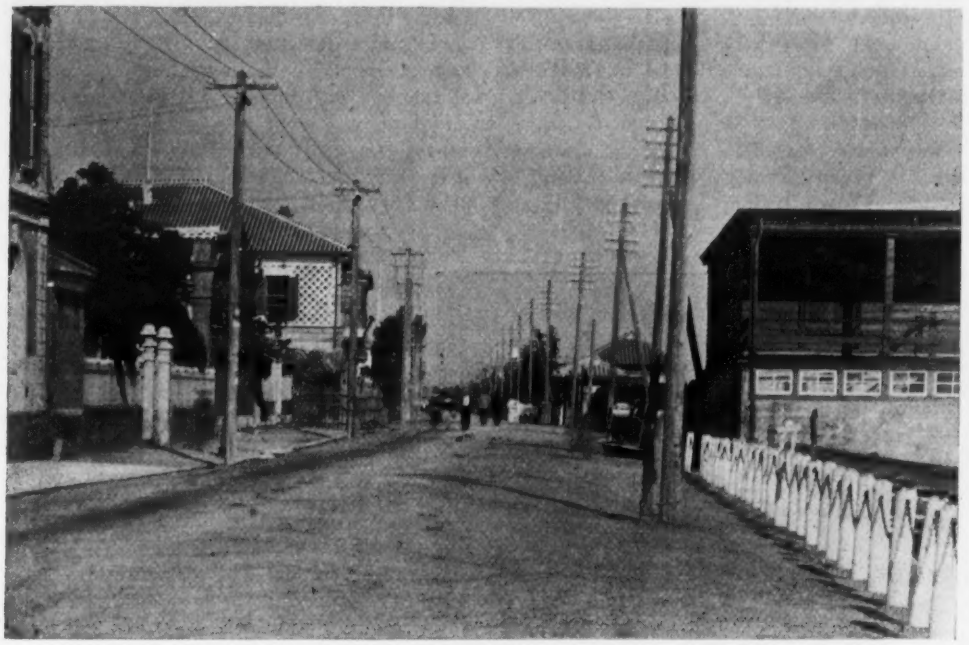


FIG. 5.—TELEGRAPH AND ELECTRIC LIGHT WIRES, KOBE.

The telephone is popular with the Japanese and it would appear that its use would continue to develop rapidly. The definite, cleancut character of each syllable in their language, the softness of their tone of voice and the patient politeness of their manners all contribute to make telephonic conversation successful. We Americans are lacking in all three of these factors of success, and yet the telephone performs a very important function throughout the length and breadth of our country.

One condition which militates against a still more extensive use of the telephone in Japan is the so-called "chit" system. This word is Pigeon-English —that extraordinary language used in verbal wrestling-matches with the Chinese and other Orientals—and means a note sent by a messenger, who obtains a receipt for the same in a "chit-book." It is quite similar to the District Messenger Service in American cities, but the extreme cheapness of labor and the fact that every one, whether rich or poor, keeps servants, makes the system much more general. Indeed it ranks as one of the prominent institutions of the Far East. As a rival of the telephone it is more powerful in China than in Japan. Probably on account of the greater con servatism of the former country.

The word "chit" also signifies a promise to pay or I. O. U., and is almost universal for small and sometimes large transactions in hotels and shops. It is a most serious evil in the Orient, causing ruin to hundreds of men who foolishly sign chits that soon aggregate an amount far beyond their means of payment. In Japan, China and India residents rarely carry any money with them, the custom being to "sign chits" for everything.

Mr. H. Igarashi, director of the Telephone Exchanges of Tokyo and Yokohama, very kindly showed and explained to me the apparatus, as well as methods employed in these cities which employ the telephone to a greater extent than all the rest of Japan.

Electric lighting in Japan is the third electrical application that has been developed to a condition of importance. In most of the larger towns there are central stations, but comparatively few isolated plants, probably because the size of individual buildings is not great, a three-story structure being looked upon as a "sky-scroper." The unpleasant frequency and severity of earthquakes is an excellent reason for not venturing very far above terra firma (which it is not in Japan).

Most of the machinery and other apparatus in use has been obtained from the United States or Germany. An electric light plant in Japan looks very much the same as in America or Europe. If it were not for the appearance of the workmen, one could hardly detect any difference. In fact, that is generally the case with the electrical installations in Japan.

The electric lighting system at Tokyo is the largest in the country, and probably larger than any other for several thousand miles in any direction, and is therefore worthy of description in some detail. The generating plant, (Fig. 7), consists of six 3-phase alternators of 260-kw capacity, each at 3000 volts, and four single-phase alternators of 150-kw, each at 2000 volts. The former were recently built by the Allgemeine Elektricitäts Gesellschaft of Berlin, and the latter were manufactured several years ago in Japan. Four of the 3-phase alternators are directly connected to McIntosh & Seymour triple-expansion engines, 400-hp at 150 lbs. steam pressure. The other six generators are directly connected to Japanese-built, triple-expansion engines. There are six Babcock & Wilcox and eight Root boilers. The total capacity of the plant is 2160-kw. The energy is distributed by three-phase transmission to three substations distant about four miles, and the single-phase current is carried about 10 miles, the voltage being raised by step-up

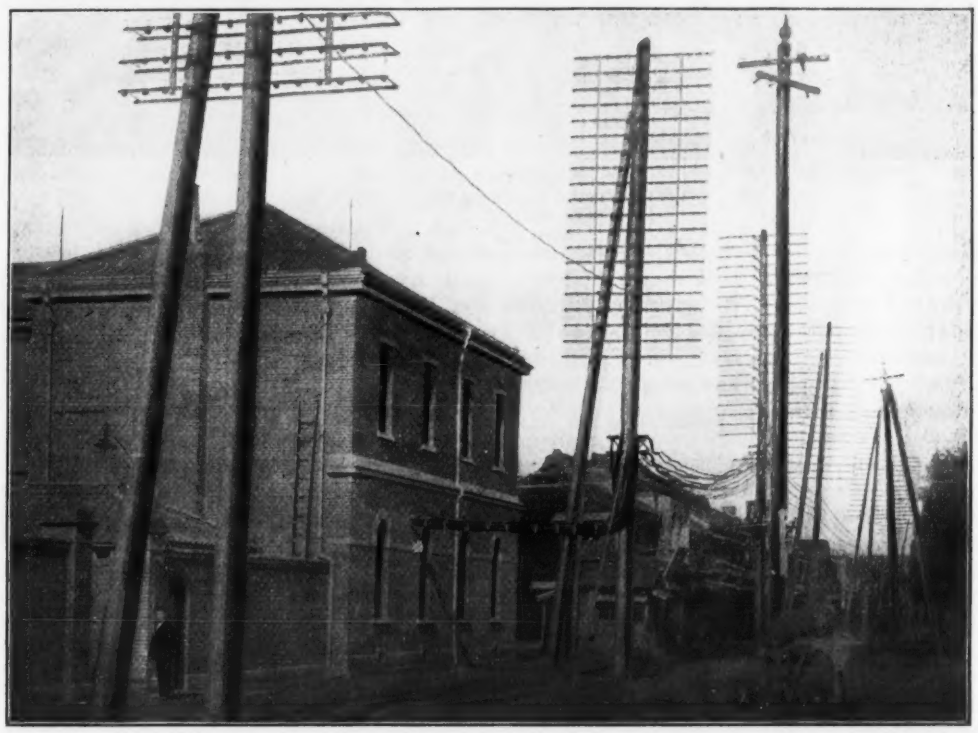


FIG. 6.—SHIMBASHI EXCHANGE, TOKYO.

transformers. Both arc and incandescent lamps are supplied, but very few motors. The design of the station building, which is provided with an overhead traveling crane, and the arrangement of the machinery are admirable as seen in the figure.

The other important cities, such as Yokohama, Kyoto, Kobe, and many smaller towns like Nara and Nikko, also possess electric lighting systems. There are some isolated plants in government buildings, large hotels, factories, mines, etc., but the number is not great when compared with those in the United States. These installations are generally quite simple in design and construction. One might expect from their attention to details, that the Japanese would be likely to lean toward the complicated, but I was much pleased to find that such does not appear to be the case, in regard to machinery. They possess natural mechanical ability as shown in their own contrivances. For example, the apparatus employed in sinking artesian wells is extremely simple and well-adapted to the conditions, and by means of it they are able to reach considerable depths at a small cost. A very deep well of this kind is being sunk in the grounds of the Imperial University at Tokyo simply for scientific investigations regarding earth temperatures and other facts which might throw light on earthquakes and their prognostication—a most important matter in that locality. The Japanese are more skillful in handling machinery than any other oriental people. They take a greater interest in it and are much more anxious to learn than the Chinese. The latter may do fairly well after being shown exactly what to do, but they are indifferent and perfunctory. The Philipinos as well as the Malays and natives of India can all be taught to operate machinery, but not one of these three races has anything like the activity and eagerness to learn that are characteristic of the Japanese. In these respects the last-named are very much like the Americans. For mechanical ability the same differences between northern and southern nations seems to exist in Asia as in Europe or America. Compare Scotch, Germans and Swedes with Spaniards and Italians, or compare the people of the northern and southern states of the Union. The reason for this general fact is readily understood when one sees how easy it is for the native to live in warm climate. No fuel is needed for warming purposes, very little for cooking, an extremely small tailor's bill, a fact or two of sugar cane or a little rice constitutes a day's rations. The "struggle for existence" consists in sitting all day under the shade of a tree. No ingenuity or mechanical aid is required in battling with nature for a living. In this connection it should be noted that Japan is a really cold country in spite of the impression to the contrary produced by pictures on fans and porcelain.

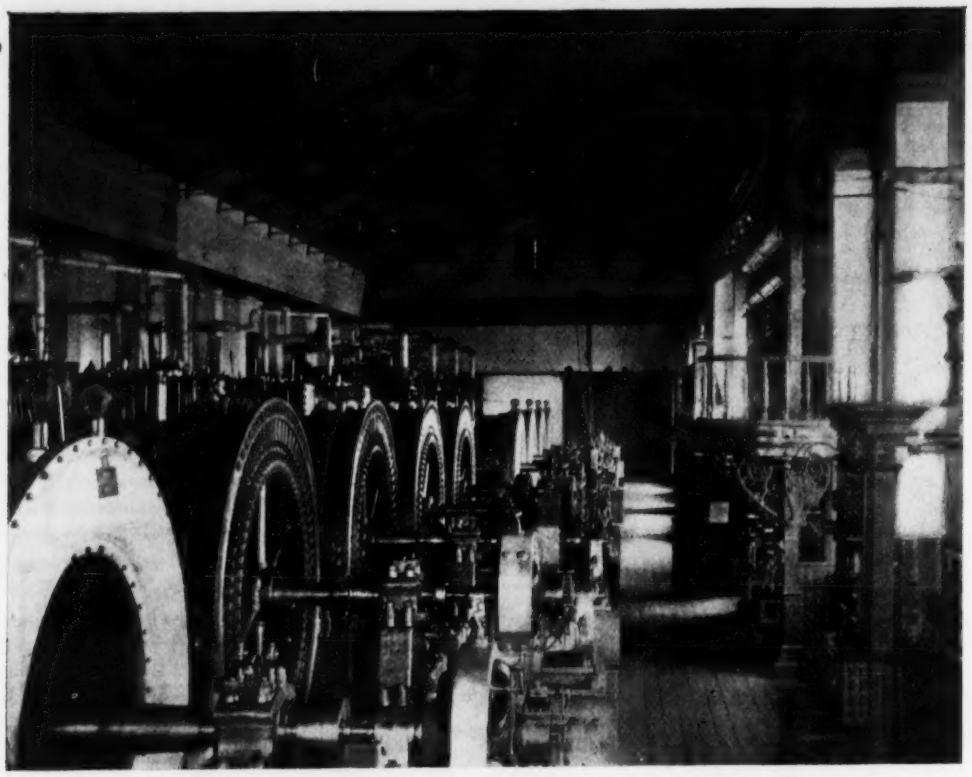


FIG. 6.—TOKYO ELECTRIC LIGHT STATION.

Resistance Detector.

By JOHN C. HENRY.

The diagrams herewith and the following description represent a new resistance detector I have recently developed for use in electric railway testing. It is something of a compromise between the differential ammeter and resistance detectors bearing my name. The new instrument has so many applications that it reminds me of an old receipt book I was familiar with in youth, which bore the title "Enquire within for anything you want to know."

In the drawings, Fig. 1 shows diagrammatically the details of the instrument and how it is connected when testing track bonds. The needle is held normally in a central position by the larger permanent magnet, *A*, acting on the smaller one, *B*. Temporary connection is made with the trolley wire by the pole *D*, the current is reduced by the resistance of the lamps to ½ ampere, and enters the instrument at the binding post *E* and divides between the solenoidal coils *H* and H_1, and leaves the instrument at the binding posts *F* and F_1. Perfect connection is made with the rail by the small files. If the bond is good the current divides equally between the coils, and the needle will remain at zero; if, however, the bond is defective, more current will pass through one coil than the other. The degree of resistance and direction of the current will be indicated on the dial. The permanent magnet, *A*, is reinforced by a compensating coil, which, when it is desired to compensate for variable voltage on the line, is connected in shunt with one of the lamps; when, however, it is desired to measure joints when the cars are running, the compensating coil must be placed in shunt with a section of the rail of known resistance, the length of this rail shunt to be determined by the weight of the rail. In this case variations in the resistance of the joints caused by the fluctuations of current are balanced by the increased magnetism of the permanent magnet. Fig. 2 shows the instrument connected to the track and to the water mains, in which case it shows the comparative conductivity of each, the direction of the current and difference of potential between the conduction. Fig. 3 shows the method of testing motors with the line current in the car house without moving the cars. Connection is made with the controller as shown; the

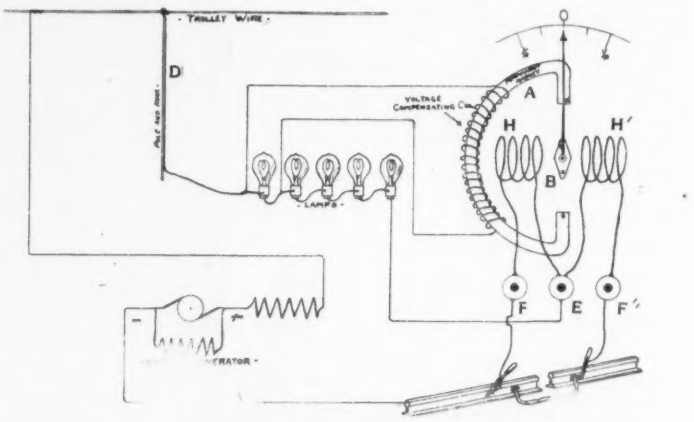
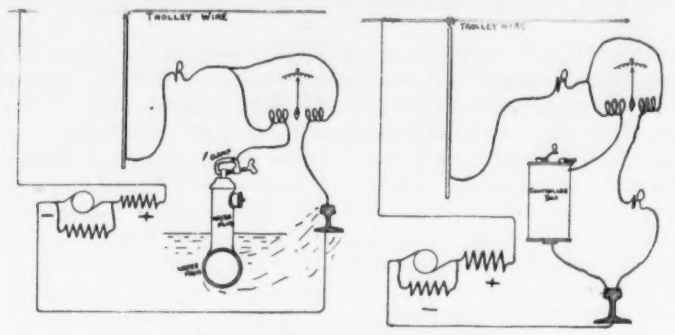


FIG. 1.—DIAGRAM OF DETAILS OF INSTRUMENT.

handle is then turned to the various positions and the indications noted on the instrument, which should correspond with tables provided, giving the resistance of the different motors in their various combinations. In order to provide for a greater range of the needle in testing motors, resistance is shown in the right-hand circuit. This is made the same as a single motor, so that when

but one motor is in circuit, the needle will stand at zero; when the mtors are in series the indications will show on the right side of the dial, and when in parallel the needle will show to the left. The



FIGS. 2 AND 3.—CONNECTIONS.

instrument will also be found convenient for testing insulations, field coils, armatures, etc.

Convention of the Association of Railway Telegraph Superintendents.

The eighteenth annual convention of the Association of Railway Telegraph Superintendents met at 10 a. m. at Wilmington, N. C., on May 17. Mr. W. W. Ryder, the president, called the meeting to order, and introduced Mayor Waddell, who cordially welcomed the delegates. The committee of arrangements, announced the extension of courtesies to the delegates by the Atlantic Coast Line, The Atlantic Yacht Club, the Carolina Yacht Club, the Southern Railway, the Norfolk and Western, the Western Union and Postal Telegraph Companies.

New members were elected as follows: William J. Holmes, New York; Joseph Hull, Jacksonville, Fla.; G. M. French, Mattoon, Ill.; J. H. Jacoby, South Bethlehem, Pa.; G. H. Groce, Cincinnati, O.; W. L. Bisbee, Houston, Tex.; W. J. Stonebrenner, Rochester, N. Y.; E. Borden, Wilmington, N. C. Messrs. Chas. McLaughlin, William Maver, Jr., J. B. Tree, and J. M. Turner, were elected honorary members, R. J. M. Danley, of Grand Rapids, Mich.; N. McKinnon, of Toledo, O., and J. L. Orbison, of Cincinnati, were transferred by unanimous vote from the active to the honorary list of members.

The following officers were then elected for the ensuing year. President L. B. Foley, of the Delaware, Lackawanna and Western Railroad, New York; vice-president, W. F. Williams, of the Seaboard Air Line, Portsmouth, Va.; secretary and treasurer, P. W. Drew, of the Wisconsin Central, Milwaukee. Mr. Foley was then installed as the presiding officer. It was agreed that when the convention adjourned on Thursday, it be to assemble again at the Monticello Hotel, Norfolk, Va., at 10 o'clock on Friday morning, May 19.

At the afternoon session Mr. Chas. F. Annett, of Chicago, assistant superintendent of telegraph, on the Illinois Central Railroad, read a valuable paper on "Electric Lighting for Railway Stations." A paper by Mr. R. J. M. Danley, on "Electric Light Plants to be Located at Railway Terminals," was read. Professor C. E. Freeman, of the Armour Institute, Chicago, read a paper entitled "The Protection of Telegraph Lines from High Voltage." Mr. G. L. Lang read a paper by Mr. C. H. Bristol, of Chicago, on "Maintenance and Construction of Telegraph Lines." Mr. Wm. Maver, Jr., of New York, then gave a practical demonstration of Marconi's system of wireless telegraph, and delivered a lecture upon the invention of the talented young Italian with illustrations on the blackboard.

In the evening a musicale, participated in by some of Wilmington's best musical and vocal talent, was given in the parlors of the Orton, as a compliment to the association, and it was closed with the singing of the "Old North State."

During the remainder of the evening, Mr. W. F. Willimas entertained the large assemblage with one of Mr. Edison's grand concert phonographs. Mr. Edison was himself a listener.

Thursday, May 18, 10 a. m. The second day's session was called to order by President Foley. A letter of greeting from Mr. E. St. John, vice-president and general manager of the Seaboard Air Line, was read. He stated that to his mind the organization is one of the most important of all connected with railways, and every line in the United States should not only have a representation therein, but send delegates thereto. This expression of opinion on the part of such a prominent railway official was greeted with much applause by the audience.

Mr. W. W. Ryder, superteindent of telegraph, of the Chicago, Burlington and Quincy railroad, Chicago, read the report of the committee on low resistance relays. The committee which consisted of U. J. Fry, G. H. Thayer and W. W. Ryder, was discharged with thanks. Mr. Ryder favorably discussed the subject of low resistance relays, and Mr. I. N. Miller, superintendent of the Western Union Telegraph Company, Cincinnati, gave an explanation as to the cause of the burning out by lightning of the usual type of such relays.

P. W. Drew, of Wisconsin Central Railroad; Charles F. Annett, of the Illinois Central, and J. H. Jacoby, of the Lehigh Valley gave their experience with this relay which was of a highly favorable character.

Detroit, Mich., was selected as the next meeting place, and June 20 the time. Messrs. G. L. Lang, J. H. Jacoby and W. W. Ryder were appointed a committee on topics for next year. Messrs. E. E. Torrey, G. C. Kinsman and J. S. Evans were appointed a committee of arrangements.

Mr. George L. Lang read a paper by George M. Dugan, of Chicago, on underground office construction. "Is the Protection Afforded by Highway Crossing Alarm Bells Greater Than the Elements of Danger and Expense Which They Introduce," was the subject of a paper, by George C. Kinsman, of Decatur, Ill. It was read by Mr. W. W. Ryder, and discussed by a number of the members.

The meeting then adjourned to reassemble at Norfolk, Va. On Friday, May 19, 10 a. m., at the Monticello Hotel, Norfolk, Va., resolutions were adopted thanking all who had assisted in the pleasure and success of the convention.

Papers were read on the subject of the advisability of using the same wire for telegraph and telephone purposes. One paper was by Mr. Charles Selden, of Baltimore, and another by Mr. Thomas D. Lockwood, of Boston. In the absence of the author Mr. Lockwood's paper was read by Mr. W. W. Ryder, of Chicago. These papers were fully discussed. During the discussion Mr. William Maver, Jr., of New York, declared that the word "composite" was a misnomer. Simultaneous telegraphy and telephony better expressed the idea, and in fact he thought that it ought to be called the Van Ryselberghe system, in honor of the distinguished Belgian inventor.

A membership committee consisting of Charles Selden, of Baltimore; George M. Dugan and W. W. Ryder, of Chicago, and W. J. Holmes, of New York, was appointed.

The convention adjourned sine die to meet on June 3, 1900, in Detroit, Mich.

Among those present were: Thomas A. Edison, W. F. Gilmore, Orange, N. J.; J. J. Ghegan, Charles McLaughlin, W. J. Holmes and wife, William Marshall, W. W. Young, A. P. Eckert, W. S. Eckert, J. R. Taltavall, William Maver, Jr., and wife, L. B. Foley and wife, L. S. Wells, W. S. Logue, wife and son, H. W. Pope, L. P. Smith, J. F. Hemenway, Wendall Baker, New York; W. W. Ryder and wife, C. E. Freeman, professor of the Armour Institute; Charles H. Bristol, wife, son and daughter, George M. Dugan and wife, W. J. Holton, wife and daughter, C. F. Annett and wife, Chicago; C. W. Hammond, wife and daughter, St. Louis; P. W. Drew and wife, Milwaukee; I. N. Miller, wife and daughter, Cincinnati; J. S. Evans and wife, Cleveland; D. H. Caldwell and wife, Fort Wayne; S. K. Bullard, Sedalia, Mo.; Dan Bullard, Independence, Mo.; E. A. Smith, Boston; C. A. Darlton, wife and daughter, Washington, D. C.; George L. Lang, Lexington, Ky.; Mrs. M. B. Leonard and son, J. B. Tree, Joseph W. Kates, Richmond, Va.; J. H. Jacoby and wife, South Bethlehem, Pa.; W. F. Williams and wife, A. C. Couldrey, Portsmouth, Va.; W. C. Walstrom, Roanoke, Va.; E. W. Vogel, Chicago; Charles Selden, Baltimore; Mrs. H. Homan, Quincy, Ill.; Mrs. O. P. Miller, Salt Lake City; W. J. Bodell and wife, Fortress Monroe, Va.; S. B. Shepherd, W. J. Crews, Raleigh, N. C.; J. M. Turner and wife, Portsmouth, Va.; A. P. Cone, Greensboro, N. C.; J. E. Macdougall, Chicago; Kenneth McKenzie, Jackson, Tenn.; H. T. Simpson, Richmond, Va.; W. E. Stoneburger, Rochester, N. Y.; E. E. Williams and wife, Birmingham, Ala.; C. H. Ashburn, L. C. Hall, W. E. Conrad, Norfolk, Va.; Joseph Dull, Jacksonville, Fla.

CURRENT NEWS AND NOTES.

LOST PROPERTY ON STREET CARS.—At its last session the New York legislature passed a bill, which has since become a law, providing for the sale of property lost in street cars, by railway corporations, the proceeds to be turned over to the employees' benefit associations.

STREET CAR BOYCOTT.—Owing to a dispute over wages, between the Wheeling Railway Company and its employees, the street cars in Wheeling, W. Va., have been put under boycott by the public which sympathizes with the strikers, and the total income has not averaged $5 a day. There would appear to be a good opening for automobiles.

CHEAP OXYGEN.—It is claimed that by the Linde process of liquefying air it is possible to separate the oxygen and nitrogen of the air and obtain oxygen at the cost of a sixth of a horse-power-hour per cubic meter, which means a fraction of a cent. Should oxygen become as cheap as this implies, it would be economical to use it in boilers and other heating apparatus. In the former case, the cost of producing liquid air would be further decreased.

THE ARC LIGHT AS A DISINFECTANT.—It has been independently noted by writers that an arc lamp has a strong deodorizing action, either by virtue of the light, the ozone or the emission of vapors. When an arc lamp is placed in a dark basement where there is an offensive closet, all the bad odors are said to be completely dissipated. This would seem to be a good reason for the use of arc lamps instead of incandescent lamps in such places.

ANOTHER HUNTER ELECTRIC RAILWAY PATENT.—A patent was issued May 16 to Rudolph M. Hunter, of Philadelphia, on a double trolley system, the application having been filed May 9, 1887. The two trolley wires are supported by separate brackets on poles at the side of the track, one wire being further away from the poles than the other, and at a different distance from the ground. The patent also describes for suitable switches in gaps where other lines cross, and connections for charging a storage battery on the car and lighting lamps in the same.

MAXIMUM DEMAND METER.—A patent was granted May 16 to H. O. Swoboda, of New York City, for a meter to indicate on a scale the maximum current transmitted through the meter within any given period of time. The current passes through a strip of metal, preferably of platinoid, which expands in proportion to the current transmitted, thus operating a lever arm which in turn moves an index hand. A method of compensation for changes in the surrounding temperature is provided on the principle of the compensating pendulum, consisting of a second strip parallel to the first mentioned, secured to it and in turn secured to the case of the instrument.

EXHIBITORS' COMMITTEE ON AUTOMOBILE RIDE.—President Baker of the Electrical Exhibition, has appointed the following committee for the automobile ride on Wednesday, May 21. H. G. Osburn, American Electric Vehicle Company; I. H. Kuh, Woods Motor Vehicle Company; J. M. Hill, Columbia Automobile Company; A. L. Ricker, Riker Electric Motor Company, and R. M. Barwise, Indiana Bicycle Company. This committee will co-operate with the committee appointed by President Young in behalf of the National Electric Light Association to take charge of and manage the affair, in which the greatest interest is being taken by delegates to the convention.

BRITISH PACIFIC CABLE PLAN.—The Ottawa correspondent of the Associated Press learns on undoubted authority that the Chancellor of the Exchequer, Sir Michael Hicks-Beach, is responsible for the niggardly financial support offered by the Imperial Government to the Pacific cable project. It is learned, however, that the High Commissioner of Canada, Baron Strathcona and Mount Royal, and the other interested agents general are apparently satisfied, from the developments of the last few days, that the Secretary of State for the Colonies, Mr. Joseph Chamberlain, who is prepared to do far more toward fostering the scheme than some of his colleagues, will ultimately prevail on the home government to contribute a considerable portion of the capital required for expenditure in establishing the projected cable.

THIRD RAIL IN NEW ENGLAND.—No better evidence of the success of the third-rail electrical system could be presented than the contemplated extension of it from Nantasket Junction, on the Plymouth division of the Consolidated road, to Cohasset, a distance of 3.4 miles. While the work of construction has not been started as yet, the rails have arrived and are being distributed along the route. A feature in the operation of this branch, and one that will attract wide interest among the managers of steam lines, will be the running of all local trains with electrical motors, the passenger equipment being that in ordinary use. For the through service the locomotive will be retained. The plan of construction will be a duplicate of the company's lines already operated by electricity, which for durability and completeness are without a rival in the United States. The enterprise of the New York, New Haven & Hartford Railroad Company in attempting the expensive experiment of applying electricity to service on its steam lines is deserving of the highest commendation, not only from the general public, but from transportation interests in general.

NEW STORAGE BATTERY PLATE.—A patent was granted May 16 to Camille Brault, of Clichy, France, for a storage battery plate which is claimed to be of small weight, high capacity and great solidity and strength. The plate consists of two parts in the form of grids; the active material is placed between the two grids, which are then forced into contact by great pressure. The ribs of the grid are of triangular section with the sharp edge inside, thus securing the paste between the two parts. The plates are held together by conical projections at grid intersections on one plate entering corresponding holes in the other plate. The active material consists of a mixture of litharge and 10 per cent. of sulphate of potassium or other similar alkali salt or of sulphate, nitrate or phosphate of sodium, potassium, calcium or magnesium. To this mixture is added 1 to 3 per cent. of the double chloride of platinum and mercury. Next, ammonia gas is made to pass through the mixture in the process of mixing. The material is then dried and powdered, when it is ready to be applied to the plates as above described. By this treatment it is claimed that the reactions in the pasty mass are slow under the influence of the ammonia gas, and that the plates prepared with gaseous ammonia are incapable.

STANDARDS FOR DIRECT-CONNECTED GENERATING SETS.—At the recent Washington meeting of the American Society of Mechanical Engineers, Mr. J. B. Stanwood read a paper on "Standards for Direct-Connected Generating Sets," in which he advocated a standard series of capacities and speeds, and in the case of direct-connected units, the standardization of those parts of the engine and generator which are connected or fastened together, in order to facilitate the assembling of the combined machine or unit. It is advocated that the number of different sizes of machines be limited, and a standard method instituted of determining the capacity of a generator which would designate with a given load or percentage of overload, a given time limit between which a permissible increase of temperature of the field coils, armature and commutator can occur. There should be at least three classes of speed for each class or capacity of generator, corresponding to the slow, medium and high-speed engines now on the market. The slow speed would be for factory, manufacturing or street railway service; medium speed for use in lighting plants or where conditions as to low first cost and a more limited space exist; and lastly, a high-speed set for places where the space is limited and low first cost is a condition. The parts to be standardized should be the shaft diameter and armature bore, which should both be expressed in thousandths of an inch. The length of shaft generally outside the engine and the location thereon of the outboard bearing should be given in inches and feet; the distances from the centre of armature to sub-base should be given in inches; and the length and width of the generator parts and the size and location thereon of the bolts which attach it to the sub-base should be specified. The council of the society was requested to communicate with the American Institute of Electrical Engineers with a view to the appointment of a joint committee to determine upon the details of the standard system proposed.

PACIFIC CABLE SURVEY.—H. M. S. Egeria will early this week starting from Vancouver, B. C., begin to survey a route for the Pacific cable from Vancouver. She will go to Fanning Island, and thence to Australia. The survey will require several months.

THE A. I. E. E. ELECTION.—The sixteenth annual business meeting of the American Institute of Electrical Engineers was held at 12 West Thirty-first Street, New York, on Tuesday, May 16. The annual report of the council showed that the total membership was on May 1, 1133, being a net gain of 35 during the year. A net cash balance in various funds of $5702.74 was reported, and other assets amounting to $5567.75. The counting of the ballots showed the election of the following officers for the coming year: President, A. E. Kennelly; vice-presidents, J. W. Lieber, Charles F. Scott and L. B. Stillwell; managers, C. O. Mailloux, S. Dana Greene, C. S. Bradley and W. D. Weaver; secretary, Ralph W. Pope; treasurer, George A. Hamilton.

AUTOMOBILE EXPRESS WAGONS IN PITTSBURG.—It is stated that automobiles are to be used by the new Pittsburg Express Company in connection with its trolley express cars. The company will conduct its business on all the traction lines in the three cities and has established agencies in Braddock, Homestead, East Pittsburg and other places in the vicinity of Pittsburg. It expects to operate 11 baggage cars and a large number of automobile delivery wagons. The wagons will be able to travel at a speed of 12 to 14 miles per hour and will be charged to run 75 miles. The baggage cars resemble the mail cars now in use on the trolley lines in the city with the exception that they are equipped with six-foot sliding doors on each side. It is the intention of the company to take up baggage for delivery at any point along the line.

A NEW YORK-BROOKLYN TUNNEL.—The Atlantic Avenue Tunnel bill, passed by the New York State Legislature and signed by Governor Roosevelt, gives to the municipal assembly of New York City the power to grant a franchise for a railway tunnel under the East River from Manhattan to Brooklyn for a term of 50 years, with the option of renewal for 25 years. The plan contemplates the cutting of a tunnel from some point in the vicinity of Broadway and Cortlandt street, New York City, extending beneath the East River to Flatbush Avenue, Brooklyn, and thence by open cuts, tunnels and elevated structures to Jamaica, L. I., via Atlantic Avenue, a distance of 12 miles. The tunnel under the East River will consist of two tubular conduits, ventilated and lighted by electricity. It is estimated that the tunnel will cost about $6,000,000, and require over two years for its construction.

NEW ELECTRIC RAILWAY CONTROLLERS.—On May 16th a patent was granted to Mr. A. J. Wurtz, of Pittsburg, for a non-arcing controller and another to Harry P. Davis, of the same place, on a similar controller. Both patents have been assigned to the Westinghouse Company. The first-mentioned controller has an addition to the bottom of the controller case, the lower part of which consists of a case carrying a switch immersed in glycerine. This switch is actuated by a friction disk arrangement, the disk being on an extension to the shaft of the usual controller cylinder. By means of the frictional disk arrangement the circuit is broken, not at the cylnder contacts, but at the non-arcing switch in changing from series to multiple, and vice versa, and while restoring controller from any position to off-notch. By this means the arcing between the usual stationary and movable controller contacts due to change in connections for changes in speeds are obviated, the arcing being confined to the isolated switch where it is reduced to the smallest practicable limits through immersion in glycerine. The second patent has a similar object in view. The controller switch has in series with it a circuit-making and breaking switch with variable resistances at its terminals, so proportioned as to smoothly, but quickly, reduce the current and at the same time prevent arcing between any of the controller switch contacts.

A NEW TYPE OF SHUNT MACHINE.—On May 16th, an interesting patent was granted to Prof. Adolf Sengel, professor at the Darmstadt Electro-Technical Institute, Germany, on a new type of shunt dynamo and motor field which enables the resistance of the shunt winding to be made one-quarter the amount at present necessary. One of the commutator bars is connected to a collector ring and the brush of the latter is connected to one end of the shunt winding, the other end of the winding being connected to one of the regular commutator brushes. It will be seen that the e. m. f. in the shunt circuit will be a pulsating one, a zero value being reached when the commutator connected to the collector ring is under the commutator brush connected with the winding; and a maximum value when that bar is 180 degrees away from the commutator brush. This commutator e. m. f. is equivalent to a combined direct e. m. f. of one-half the value of the dynamo e. m. f. and an alternating e. m. f. whose maximum value is also one-half that of the dynamo e. m. f. Owing, however, to the great self-inductance of the field coils, the current passing through will be practically that due to the direct e. m. f., since the small quantity of current due to the alternating e. m. f. will give rise to an inductive e. m. f. that will choke back further alternating current. Consequently, the action will be the same as if the field coil were connected with an e. m. f. one-half that of the dynamo. In machines of high potential this will result in a notable saving in expense, and in less risk of damage to the field coils in case of careless breaking of shunt circuit. When applied to motors, there is additional advantage that in starting the exciting current will be twice as great as in normal working, with a consequent increase of starting torque.

THE CANADIAN NIAGARA POWER COMPANY.—The negotiations for the surrender of the monopoly held by the Canadian Niagara Power Company have been concluded. The company has agreed to abandon its monopoly in return for a number of concessions. In place of the present annual rental of $25,000 per annum, a tariff of rates has been decided upon. Under the new agreement the company, instead of a fixed yearly payment, will pay in proportion to the power which it develops. The new tariff is as follows: For the first 10,000-hp developed, $15,000 per annum; for the next 10,000-hp, $1 per horse-power per annum; for the next 10,000-hp, 75 cents per horse-power per annum; for the remaining power developed up to 100,000 horse-power, 50 cents per horse-power per annum. It will thus be seen that under the new arrangement, the revenue derivable by the Ontario Government for the first 30,000-hp developed, will amount to $32,500. If the company develops up to 100,000-hp, it will pay a further sum of $35,000, making a total revenue of $67,500. In the consideration of the above agreement the Ontario Government will be aided by a very important report made by Mr. Kennedy, engineer to the Montreal Harbor Commission, and one of the most celebrated authorities on hydraulics on this continent. In conjunction with Mr. Wilson, engineer to the Niagara Park Commissioners, Mr. Kennedy made a careful and extended examination of the water-power at the Falls, with a view to determining, as nearly as possible, the quantity of power that could be developed. His report together with carefully prepared plans, shows that there is no danger of a "corner" of power on the Canadian side. The Canadian Niagara Power Company proposes to erect a plant capable of developing 120,000-hp. Mr. Kennedy estimates that it is easily possible to obtain a further development of five times that quantity above the Falls. The intake of the Canadian Niagara Power Company will commence at the south end of Cedar Island. Other developments can be had further south, and including the point where the Welland River enters the park, so that there is ample power for any new companies desirous of obtaining development rights. The Canadian Power Company is seeking development privileges, but it is stated that negotiaitions with it will remain in abeyance until the monopoly agreement has been finally disposed of. The probability is that it will be given the right to develop on the same terms as the other company has been granted.

STORAGE BATTERY REGULATION.—Three patents were granted May 16 to Justus B. Entz on methods of regulation in connection with storage batteries, whereby a generator may be given a constant load regardless of the load in the working circuit. The first patent has for its object to keep the load on a generator or generators practically constant, and to cause a storage battery to compensate for changes of load occurring in the working circuit. To this end there is employed in connection with the battery a booster with three windings—a shunt winding and two series windings acting in opposition to the shunt. One series coil is in the main or generator circuit on one side of the battery junction, and the other in the main circuit beyond the junction—that is, in the service portion of the working circuit. Under certain conditions

of load, the shunt coil is balanced by the two series coils, and the booster voltage is zero. In the event of an increased load in the service or working circuit, the coil in that section by its action on the field of the booster causes the voltage of the battery to be raised by the same amount it tends to fall by reason of an increased discharge corresponding to the increased load. In the case of a decreased load the opposite actions occurs, and the booster lowers the battery voltage and causes it to take more current. The second series coil compensates for the condition that in practice the change in voltage of a battery for a given change in current depends upon whether the battery is more or less fully charged. The second patent relates to a means of keeping the load constant upon a compound wound generator, having a battery in multiple with it. In one case a series-wound booster is employed in the battery circuit, with its field so adjusted as to compound the battery and keep its voltage constant throughout its entire range of discharge; or the booster may have in addition to the series coil, a shunt coil, so that a certain definite voltage may be added to or subtracted from that of the battery. In both cases a small storage battery is placed in multiple with the series field of the compound generator, which keeps practically a constant current in the series field and thus imparts to the generator the characteristic of a shunt machine, the voltage rising for a decrease in load and vice versa. The third patent is for means to keep a constant potential in one part of a circuit, in another part of which there is a fluctuating load, such as that of an elevator motor load. A storage battery is placed in multiple with the motors or other fluctuating load, and between the generator and battery a booster driven at approximately uniform speed is interposed, and having a constantly excited field with a series field in opposition thereto. A change of current through the booster automatically effects a change of voltage of the booster, which resists the change of current. Thus a change of relative voltage between the generator and battery that would otherwise cause a great change on reversal of current between the two, is limited to a comparatively small amount.

LETTERS TO THE EDITORS.

The Drying Up of Water Powers.

To the Editors of Electrical World and Engineer:

Sirs—In your issue of May 6, reference is made to the "drying up" of the California water powers. It is a fact that at regular intervals there is less fall of snow and rain than usual, thus causing very low water in the August and September following. It is also a well known fact that considerable amounts of snow and rain may fall late in the season and go off with the spring freshets, doing no good towards keeping up the high water during the late summer. It is a fact, however, as you suggest, that these recurring intervals do not show any permanent change in the climate of this coast.

I take pleasure in enclosing with this a map published by the Central Pacific Railway, compiled by Herman Schussler, showing the rainfall in this city for the past fifty years. In the printed explanation, you will note that Mr. Schussler comes to the same conclusion that you have, viz.—that there is no permanent climatic change taking place on the coast.

THOS. ADDISON.

SAN FRANCISCO, CAL.

Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs—I note in your issue of May 20 an expressed desire for a theory of wireless telegraphy which shall satisfactorily account for the present methods using ground connections and aerial wires, which have been experimentally found to be successful. I venture to ask why the following conception is not simple and sufficient.

As far as my limited investigations have gone, they have seemed to show that the breaking down of the resistance of the coherer is not due to electromagnetic waves falling on the coherer but to highly oscillatory currents set up within its circuit. These currents may be generated by the electromagnetic waves and appear coincidentally with them, but I do not think that the waves directly affect the resistance of the coherer. This can be shown by the simple means of connecting a coherer in series with a circuit suitably arranged to generate oscillatory currents due to electromagnetic waves. The position of the coherer itself with reference to the waves is immaterial, as it works equally well in any position provided that the receiving circuit is in the proper position.

A coherer supplied with wings may receive electromagnetic waves which will cause oscillatory currents to travel from wing to wing and break down its resistance; or it may be connected in series with a circuit in which oscillatory currents are induced from any cause and its resistance thus broken down. The coherer provided with the wings receives true Hertzian waves, transforming them into oscillatory currents. This system has been tried by Marconi and has been found to be effective within a range of two miles.

By means of a reflector Marconi has shown that Hertzian waves may be directed at the coherer and will cause it to operate, but if the coherer is out of line with the projected waves it will not respond. Further than this, the wings of the coherer must be accurately adjusted to a condition of resonance in order that the frequency of the oscillatory currents shall be some simple multiple of the frequency of the impressed waves.

Concerning the second system of wireless telegraphy using ground connections and aerial wires, I venture to suggest that the coherer is not affected by the Hertzian waves transmitted, and in support of this statement I suggest the consideration of the following experiments and their application to the long-distance Marconi system.

If to a free terminal of an induction coil a length of wire is connected, and the induction coil is set discharging across its spark gap, oscillatory currents will be induced in the wire so connected. If a coherer is placed in circuit, its resistance will be broken down at such times as the oscillatory currents are generated.

The long distance Marconi system is a precise analogue of this arrangement. One terminal of the induction coil is connected to earth, the other to an aerial wire. At the distant station one wire of the coherer is connected to earth, the other to an aerial wire. On the ends of these aerial wires a capacity in the shape of a plate or ball can somtimes be fastened with advantage. We then have a circuit from one terminal of the induction coil, through the earth, through the coherer to an air wire, through which oscillatory currents are transmitted, passing through the coherer and causing it to act. In this system the position of the coherer with relation to any Hertzian waves that might be generaed, is of no importance, showing conclusively, so it seems to me, that Hertzian waves are not the factor.

Inferences may also be drawn from the facts that a second station may be set up in any other locality within a certain radius and will receive signals just as well as the first station; that no preliminary adjustment for resonance is necessary, and that obstacles which are known to effectively screen Hertzian waves can, in the ground connection system, intervene without causing trouble. Briefly summed up, this system is a single conductor telegraph system, that conductor being the ground. The two air wires and the air constitute a condenser which is charged by the coil and discharges through the spark gap. In circuit with this condenser is the coherer receiving the oscillatory currents.

Regarding the choke coil in the coherer circuit, this, it seems to me, is consequently very necessary in order that the oscillatory currents which traverse that instrument shall not be shunted off through the relay, thus failing to exert their full effect on the coherer itself.

NEW YORK, N. Y. GEORGE T. HANCHETT.

The Nernst Lamp.

To the Editors of Electrical World and Engineer:

Sirs.—In the discussion which took place in England after Mr. Swinburne read his paper on the Nernst lamp, it is curious to note that only one gentleman (Mr. Campbell Swinton) mentioned the work years ago of Jablochkoff. In view of the interest now being taken in the Nernst lamp, I give the following extracts, which show that Jablochkoff took highly refractory substances, as kaolin, magnesia, lime, etc., and made lamps with pencils two millimeters thickness and one centimeter wide; that he found his lamp an insulator when in the cold state, and that it was found necessary to heat it up before it would conduct electricity.

In the English translation of "Electric Lighting," by Comte Th. Du Moncel, published by George Routledge & Sons in 1882, the following occurs (page 140):

"In this new system the induction-currents from a Ruhmkorff coil of moderate dimensions are used, and a piece of slightly baked kaolin, two millimeters thick and one centimeter wide, which forms the semi-conducting substance, is required to supply the incandescent point, or rather the luminous source, for the whole appears to be illuminated.

"The arrangement of the system is very simple; the small piece of kaolin is introduced between two little iron nippers which form the polar electrodes, and which are themselves attached to two clips capable of moving horizontally by means of a screw. These nippers seize the piece of kaolin by its upper slightly thinned edge, and even a little beyond this edge, in order that the apparatus may be more easily lighted; for this apparatus must be lighted, and it will readily be understood that the substance is not of itself sufficiently conductive, even of induced currents, to be capable of passing a current able to produce the electric light. To remedy this defect of conductivity, the plate of kaolin must be warmed in the neighborhood of the electrodes, and this is done in a very simple manner, by connecting the two iron clips mentioned above by a rod of retort carbon. By first taking a spark from one of the clips the carbon glows and transmits its heat to the neighboring part of the kaolin, which fuses and affords a passage to the electric influence, at first through a very short space (1 or 2 millimeters), then over one progressively longer in proportion as the carbon is moved along the kaolin, and which at length occupies the whole length of the latter when the carbon has reached the second iron clip. The current then follows the track of fused matter which is progressively formed, and reveals itself to the eye as a band wider than it really is on account of irradiation. Care must be taken to concentrate the heat developed by the carbon by means of a reflector of refractory matter, which may consist of a plate of kaolin. The light thus supplied is, as I have already said, very steady, very brilliant and much softer than the arc light. Its power depends, of course, on the resistance of the circuit and on the number of luminous points interposed, but with a weak electric force it is equal to one or two gas jets. Kaolin appears to be the best substance because, being prepared as a paste it can be made very homogeneous; but other substances are capable of producing the same effects; magnesia, and lime have indeed given very good results."

In a foot note on page 141, we find further:

"The conductivity of this kaolin, studied by means of the process used in my researches on substances of mediocre conductivity showed traces of the passage of the voltaic current produced by 12 Leclanche elements only when the specimen had remained in a cellar for more than a day. When it was kept in an inhabited apartment it gave no deviation, and when it was heated to redness in a spirit lamp it gave a deviation of only one degree. It is therefore necessary in order to obtain the important effects that have been mentioned, that electricity of tension should in consequence of the resistance it meets in its passage, be accumulated within the very substance of the bad conductor, and should be transformed into heat by not being able to flow away fast enough as an electric charge."

Then again on page 142 we find that:

"When the illumination of a long strip of kaolin is required under the influence of a very powerful current, it becomes necessary in order to light it to make a line of lead on the upper edge of the bad conductor from one electrode to the other. The current is at first conducted by this streak, but is not long in heating the kaolin and in producing the effects we have described."

Further on we find in relation to the intensities of the lamps:

"They may, therefore, be so arranged as to supply light of different intensities from their minimum light of 1 or 2 gas jets up to a light equivalent to 15 jets."

There is still further matter of interest in connection with the work of Jablochkoff to be found in the book mentioned above, and from what has already been shown, it will be seen that Jablochkoff's experiments bear far more seriously on the claims of Nernst, than the Japanese experiments with plates of glass, zinc and copper, or in regard to the glow worm, as mentioned in the discussion at the time.

From what is found in print since 1882 in the book of Du Moncel, there can be no doubt that Jablochkoff had an incandescent lamp consisting of a material that is a non-conductor when cold, and a conductor when heated to a high temperature, and these facts are thus public property, and leave a very large door open for other inventors to work on the same principle as those upon which the Nernst lamp is constructed.

In fact, it is not Prof. Nernst, who circulates the sensational reports and probabilities concerning the lamp that bears his name, as he is a modest man.

Nearly twenty years ago Edison made a lamp which consisted of a tiny spool of refractory material wound with a layer of platinum wire. As the writer was an assistant of Edison at the time and stationed in Menlo Park, he remembers those experiments very well.

We made tiny spools and cylinders of zirconia, magnesia, lime, etc., also different mixtures of such refractory material and substances. When a current was sent through the wire, the cylinders or spools of the lamps, as the case might be, were heated up to a very high temperature and emitted a brilliant soft light. We were aware at the time that the tiny spool or cylinder conducted current when hot, for it often happened that the platinum wire got fused, that is, broken, but still the spool continued to glow. These facts can no doubt be found among the records of the experiments made at Menlo Park.

FRANCIS JEHL.

BUDAPEST, AUSTRIA.

Two-Phase vs. Three-Phase Systems.

To the Editors of Electrical World and Engineer:

Sirs.—As to the relative advantages of the two and three-phase systems, I will state at the outset that in my opinion this question only has a commercial importance, and that from a technical standpoint I consider the two systems to be of about equal value.

It is well known that three-phase transmission lines are more easily constructed than the two-phase lines, and that they cost about 25 per cent. less. Further than this, it is the custom to use two single-phase transformers with the two-phase system, which increases the cost by about 20 to 40 per cent. Here and there, however, special two-phase transformers have been built, resembling three-phase transformers, in which only the outer iron core was covered with winding. By the use of these the cost is somewhat reduced, but these apparatus are not to be recommended, as the phases have a mutual influence on each other.

The assertion made in your editorial note to the effect that two-phase converters should have 25 per cent. more output than three-phase converters, is entirely new to me.

I consider this opinion as absurd as if any one would make the statement that of two equally large continuous current machines, one having twice the cross-section of wire as the other, the former would have twice the output.

It appears to me that the iron losses and the formation of sparks play as important a part as the ohmic losses. Besides, the number of actual cases in which converters must be provided for is so small that it need not be taken into account in the consideration of this question.

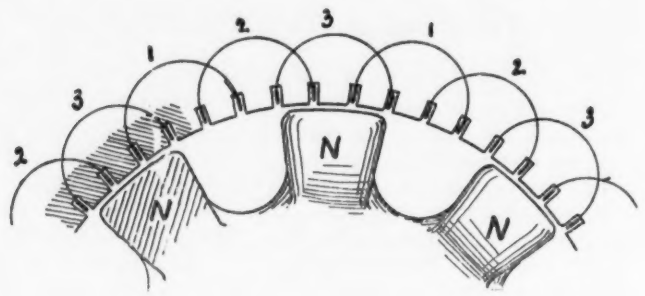
In regard to the purely mechanical side, there seems to be but little difference between the two; but if there is any advantage, it is slightly in favor of the two-phase system.

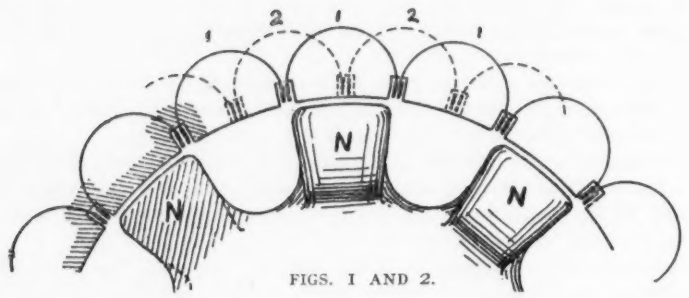
Motors.—If the rotary field (induction) motors are wound according to the formula, the number of conductors must be divisible by six (6), so that the terminals will all be located on the same side. If this condition is not fulfilled and the conductors are nevertheless brought out at the same time, a certain non-symmetrical field will be developed and an unbalancing of the three phases will take place, which in turn will decrease the output. This difficulty, if we may call it that, is not present in the two-phase system, as the winding is symmetrical under all conditions. The choice of the number of conductors in two-phase motors is therefore a much simpler problem. I might mention here, as a curiosity, that I once tried to obtain symmetry in a 120-hp rotary field motor to which a brake had been attached, and the winding of which was not in accordance with the above conditions, by leading the third connection to the collector ring through the interior of the iron ring. The consequence of this was that the motor only had half the torque. If, therefore, circumstances do not permit the use of a number of conductors divisible by six (6), it is always preferable to have the three terminals on the same side and obtain a somewhat non-symmetrical field, than to lead the connection through the interior of the iron.

Generators.—In regard to generators, it is a little more difficult to

make a comparison, as the advantages and disadvantages of the two systems are largely dependent on the types of the machines. For the types most commonly built at the present time, using stationary winding and two rotors shifted axially, the following is applicable: In order to obtain an approximately symmetrical curve with the three-phase current it is necessary to employ cross-connected coils (Fig. 1), while each two-phase armature can be wound single-phase (Fig. 2). The winding and crossovers of the coils are somewhat simpler in the latter case.

The separation of the two phases has the further advantage that it permits the employment of a so-called "amortiseur." This consists, as is known, of supplying the magnet pole with slots or tunnels containing a short-circuited winding, similar to those used on induction motor secondaries, in which the armature reaction induces currents opposed in effect to the armature reaction. Experience has shown that in this way the fall of e. m. f. is reduced to nearly one-half. As a rotary field is always produced in multiphase windings which rotates synchronously with the fields, it will be seen that the effect of the "armortiseur" for such a winding is zero. If each phase, however, is taken care of by one armature, then the machine behaves like an ordinary single-phase generator, and the drop of e. m. f. can by this means be considerably reduced. In conclusion,





FIGS. 1 AND 2.

it has to be remarked, that rotary current machines, built after this pattern for the same drop of e. m. f. and iron losses, are somewhat heavier than two-phase machines. In order to show this we will use the following notation:

I = current strength of one phase $= \frac{\text{effective current}}{\cos \phi}$

E = effective e. m. f.

$E_1 = n . E$ = terminal e. m. f.

e = e. m. f. of self-induction.

$\cos \phi$ = power-factor.

N = number of series windings of one phase.

$i\,n$ = ampere windings of the magnet.

Φ = number of lines of force leaving one pole.

m = number of phases.

$\omega = \frac{p\ v}{60}$ = number of cycles.

v = number of revolutions per minute.

$\mathfrak{B}$ = density of air gap.

D = diameter of armature.

l = length of armature.

Then as is well known:

$$E_1 = \eta . E = \eta . K\ \omega . \Phi . N . 10^{-8} \ldots\ldots \quad \ldots\ldots (1)$$

Coefficient K depends on the winding and construction of the machine and varies for machines with alternating poles between 2 and 4, for machines with stationary winding, between 1 and 2.

Referring to diagram, (Fig. 3), in which the armature resistance has been neglected, we obtain for the terminal e. m. f.:

$$E_1 = \sqrt{E^2 - e^2 \cos^2 \phi} - e \sin \phi . \ldots\ldots \ldots\ldots\ldots (2)$$

or

$$\frac{e}{E} = \sqrt{1 - \eta^2 \cos^2 \phi} - \eta \sqrt{1 - \cos^2 \phi} = x \ \ldots\ldots \ldots (3)$$

In this equation η and $\cos \phi$ are known. Now, as is well known, the e. m. f. of self-induction has about the same relation to the induced e. m. f. as the ampere turns of the armature have to the ampere turns of the field coils, or, more accurately:

$$\frac{e}{E} = x = K_1 \rho . \frac{I . N . \sqrt{2}\left(\frac{m}{2}\right)}{p\ i\ m} = K_1 \rho \frac{I . N . \sqrt{2}\left(\frac{m}{2}\right)}{p \frac{4\pi}{10} 2 \delta a \mathfrak{B}} \ \ldots\ldots (4)$$

ρ is unity with a short-circuited winding, and for other shifting of phases, varies between 0.6 and 1.0, according to the construction.

K_1 depends on the construction and varies between 0.5 and 2.

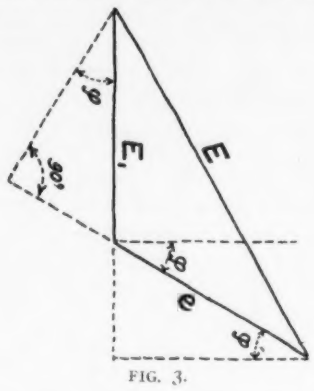


FIG. 3.

δ = air gap in cms.

a = relation between entire magnetic reluctance and the air resistance and varies between 1.5 and 2.5.

For single phase machines, $\frac{m}{2} = 1$.

From eqs. (3) and (4) we obtain

$$N = \frac{10}{4\pi} . \frac{\mathfrak{B} . 2\delta . a\ x}{K . \rho . I \sqrt{2}\left(\frac{m}{2}\right)} \ldots\ldots \ldots\ldots \ldots\ldots (5)$$

If we finally put

$$\Phi = \frac{D\pi . \beta}{2p} . l . \mathfrak{B} \ldots\ldots \ldots\ldots \ldots\ldots (6)$$

and substitute the values of N and Φ in equation (1) we obtain

$$D \times l = \frac{E_1 I \left(\frac{m}{2}\right)}{a} . \frac{226 . 10^6 K_1 \rho}{\eta . a . \beta . \chi \mathfrak{B}^2 \delta\ K} \ldots\ldots \ldots\ldots (7)$$

It must have been noticed that in equation (7) the number of revolutions does not appear. From this we gather the interesting conclusion "that the dimensions of an alternating-current machine of a given capacity, number of periods and drop of potential is theoretically independent of the number of revolutions;" in other words, machines revolving at different speeds would with the same saturation, etc., have the same dimensions, and, further, a two-phase machine would be half as large as a single-phase machine.

That this is not actually the case is easily proved by the impossibility of designing machines having different speeds after the same patterns. In reality, no account is taken in equation (7) of the space required for the armature winding, which necessarily brings about a reduction of the cross-sectional area of the iron, necessary for the induction. But according to equation (5) the number of coils per armature tooth is independent of the number of poles.

The winding space per tooth also varies but little with the number of poles, and rather becomes larger as the number of poles increases. The smaller, therefore, the number of revolutions, the larger will be the number of poles for the same number of periods and the smaller the effective armature area. It is, therefore, necessary to decrease the saturation, $\mathfrak{B}$, which according to equation (7), will increase $D \times l$. For this reason the apparently important advantage which the two-phase machines have over the single-phase ones is considerably lessened.

In order to determine the winding space we can eliminate v by means of equation (4). We further introduce the number of ampere-turns per cm. of armature circumference:

$$p = \frac{I \cdot N \cdot \left(\frac{m}{2}\right)}{D\pi} \qquad (8)$$

From which follows:

$$D^2 l = \frac{E_1 \cdot I \left(\frac{m}{2}\right) 4.32 \cdot 10^8 \cdot p\, \delta\, a\, x}{v \cdot \eta \cdot k\, p^2\, \beta\, k_1 \cdot \rho} \qquad (9)$$

The formulæ (7) and (9) are equally convenient for calculations, for both give armature area, but the former gives a better idea of the iron losses, while in the latter exclusive attention is paid to the winding space.

We compare, for example, two similar machines built after a continuous current type with drum or Gramme winding, of which the one has two collector rings (two-phase), and the other three collector rings (three-phase), $\beta = 0.66$, then the coefficients K are to each other as 1.5 : 1.94 and the coefficient K_1 as 1.15 : 1.

With the same excitation and the same percentage drop of pressure the relation between the capacities of two-phase machines and three-phase machines, independent of the heating, is as 0.67 : 1.0. It must be added, however, that this difference will be made somewhat smaller if the machines are wound for the same e. m. f. We can nevertheless, plainly see that this type is more favorable for three-phase machines. In fact, in modern machines, with a central stationary magnet coil, this ratio is even in favor of the two-phase machine, As it is necessary in three-phase machines, in order to obtain a symmetrical curve, to employ cross-connected coils, K is about equally large for both machines.

K_1, however, for a two-phase machine has a mean value of 0.6, for a three-phase machine 0.65.

In addition to this, three-phase machines have six slots instead of four per pole, which naturally decreases the iron section a trifle.

We can, therefore, say that three-phase machines of this type of equal size and drop of potential have on the average 20 to 25 per cent. less output.

Many other comparisons can be made, such as the one pointed out by experience that it is practically impossible to construct low-tension two-phase machines, with exactly 90 degs. difference of phase, due to the mutual induction of the front-end connections, etc.

It is, however, not my intention to make further comparisons, as I only desire to point out some of the peculiarities of the two systems as far as they relate to the construction of machinery.

J. FISCHER-HINNEN.

LE RAINCY, FRANCE.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Method of Determining the Slippage in Induction Motors.—The *Zeit. fuer Elek.*, April 30, abstracts a recent paper by Dr. Hoor in which, after showing that the usual methods of determining this important quantity are crude, unreliable and inaccurate, he describes what he considers to be a very much better one which will give accurate results and requires only very simple apparatus. It consists in a determination of the number of current impulses per minute in the inducing circuit, this number of impulses being equal to the difference of the primary and the secondary pole changes. It may even be used for determining the slippage when the motor is short circuited. He measures the current pulsations by means of a sort of transformer made of a small coil which is surrounded by one turn of the mains, a telephone being in circuit with the secondary coil. Experience has shown that the method is a very simple and effective one. The coil which he uses has an outside diameter of 6 to 7 cm and contains between 300 and 400 turns of 0.2 mm copper wire. The telephone shows the maxima and minima of the current quite plainly, and with the ear it is easy to calculate 250 to 300 and even up to 500 pulsations per minute. With 5,000 pole changes he can determine a slippage of 10 per cent. quite accurately. Instead of the telephone any other sensitive current measuring instrument may be used. Even the smallest slippages occurring in practice can be determined accurately.—Hoor. *Zeit. fuer Elek.*, April 30.

Tests of a Dynamo Which Fails to Excite.—The Lond. *Elec. Eng.*, May 5, contains a list of the faults that should be sought or tested for in case a dynamo fails to excite itself. Briefly they are as follows in their proper order. Make sure that the brushes are on the right place on the commutator and are set properly relatively to one another. If the armature has more than one circuit the brushes must cover more than one commutator bar at a time; the machine must be run at least at its proper speed; see that the shunt winding is actually connected to the brush; try for earth leakage; there may be a short circuit in the brush rocker; there may be a break in the field winding; if it still refuses to excite it is advisable to change the shunts over by crossing the brush flexibles; see that the field winding is so connected that it gives the proper sequence of the poles; if there is a slight sign of a field, connect the two shunt windings in parallel, if that is possible. If the machine is compound see that the shunt windings are not opposing each other; if none of these defects are found, examine the armature of which some of the coils may be short circuited. If nothing can be found run the machine separately excited and see if the armature gives its normal out-put, and if it does not and is a new machine, there is some fault of the armature. If after this there is no effect, the case is hopeless. —Lond *Elec Eng.*, May 5.

Three-Wire Transformer.—A brief illustrated description of the Union transformer, the primary of which is connected to a two-wire system and the secondary to a three-wire system. The chief feature is that the two secondary coils are each divided into two separate coils connected in series, one of which is on one limb of the transformer and the second on the other limb. Thus no matter how much the third wire circuit is unbalanced the current in the coils and therefore the magnetism will be symetrically distributed in the transformer.—*L'Eclairage Elec.*, April 29.

Phase Transformer.—A method is described by Mr Spitzer in the *Zeit. fuer Elek.*, April 30, which appears to consist of a combination of the primary current in series with the secondary current of a transformer, whose primary is fed from the same generator. In this way he can produce a phase shifting which is not only less than 180° but which will have an exact predetermined angle of phase shifting. He illustrates the method by the complete calculation of an example.—Spitzer. *Zeit. fuer Elek.*, April 30.

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Calculation of Two-Phase Induction Motor.—A brief description of a method of calculating the rotor quantities; it is claimed to be a practical method and not absolutely accurate, but quite sufficient for practical purposes.—Eborall. Lond. *Elec. Eng.*, May 5.

Alternating Current Motors.—Brief illustrated descriptions taken from patent specifications.—Guilbert. *L'Eclairage Elec.*, May 6.

Theory of Non-Synchronous Motors.—The conclusion of the article noticed in the Digest May 20; he discusses single phase motors. —Heubach. *Elek. Zeit.*, May 4.

Large Unit at Manchester.—A brief illustrated description of the 2500-hp direct current and direct coupled generator for the Manchester station.—Lond. *Elec. Rev.*, May 5.

TRACTION.

Accumulator Traction.—Dr. Sieg recently read a paper before a society in Cologne, a reprint of which is begun in the *Elek. Anz.*, May 4. He describes the small line at Bremerhaven and gives the results of tests and measurements. The line is 4.3 km in length and is being run by the company who made the accumulators; there are four motor cars and two trailers in use, the former holding 40 passengers, and weighing, empty, 7 tons; the total weight of the batteries and passengers is 12 tons; each car has two series of motors of 10-hp, working with a reduction of 1 to 4, and they are connected in series or parallel. The batteries are intended for a three-hours run; each battery consists of 86 cells weighing complete 28-kg, the whole battery therefore weighing about 2.5 tons; a single charge suffices for a run of 60-km, although a run of 100-km was made under favorable circumstances; the accumulators are recharged, however, for a run of about 45 to 50-km, and they appear to be charged on the

car, the energy delivered to them being carefully measured. The charging station also contains a storage battery for charging at night when the machinery is not running. The plant is a small one, and the conditions are as a rule favorable, as there are but few grades. The detailed results of a two-weeks test are given, and it was found that the consumption of energy was about at the rate of 470 watt-hours per car-km delivered to the battery, and including current for 6 lamps of 16-cp. The consumption of coal is also moderate, and he believes that every other system of electric railways under the same circumstances will involve at least the same cost for the current. No data is given concerning the important question of the cost and maintenance of the battery, as the time has been too short to determine this, but he believes the company will be safe in maintaining the batteries for any length of time for about 0.6 cents per car-km. The results of some tests made at different speeds are also given.—Sieg. *Elek. Anz.*, May 4.

Analysis of the Operation of an Interurban Railway.—In an extended article with full illustrations in the *St. R'y Jour.*, May, the Lorain & Cleveland Railway is discussed. It extends over the city streets in Cleveland a distance of 8.5 miles to Rocky River, thence a distance of 18.5 miles to Lorain. For the first section the cars run over the tracks of the local railway company; the last 18.5 miles over its own roadbed, taking the power from its own station, and at high speed. In winter the cars run every hour, and in summer every half hour. The discussion is entirely on the section of the line from Rocky River to Lorain. The track is of T rail, weighing 70 lbs. per yard, and built according to regular steam railroad practice. It has a single track, with turnouts, and two No. 000 trolley wires. The tension of the trolley wheels on the trolley wire is from 35 to 40 lbs. The trolley wheels now used are 7 inches in diameter. The life of a 6-inch wheel is about one week. The cars are equipped with four 50-hp motors each. The electric brake is used. The cars run 340 miles per day each, 240 miles of which are on the company's own tracks. In winter three cars are used and in summer six. The average current consumption is 140 amps. at 565 volts. A speed test given shows an average of 43.8 miles including stops and a maximum speed of 55.5 between stops. The track is nearly level. An average day in winter shows kw hours 3227, car miles run 823, average kw hours per car mile 3.9, coal per kw hour 21.5 lbs. The power station was put in operation October 1, 1897. There are four 300-hp water tube boilers, two compound Corliss condensing engines directly connected to 400-kw generators. A test is given of the power station, showing fuel consumption per hp hour, etc., at average loads. With an average load of 30.8 per cent. of the maximum, the pounds of water power per kw hour was 41.34 lbs., and with an average load of 47.2 per cent. as compared with the maximum load the consumption of water was 38.55 lbs. per kw hour. The article discusses the effect of the percentage of the average load on the maximum and its effect on the economy of the station. This is brought out in the diagram which shows the result of daily tests made to determine the economy of different loads. A line is drawn through the diagram to show the mean average of all records and indicates an increasing economy with increase of load factor.—*St. R'y Jour.*, May.

Formula for Train Resistance.—Henry Graftio, who is engineer of ways of communication of the Russian Government, gives in an extended and interesting article in the *St. R'y Jour.*, May, a summary of some of the tests for train resistance carried on in Europe and elsewhere. These confirm the opinion of Merssrs. Sinclair and Lundie that at high speeds the resistance of trains seems to increase as the first power and that Newton's formula is erroneous. He first takes up Mr. Crosby's curves, which show that the resistance can be plotted by straight lines. In the second diagram he plots out two series of curves, one for locomotives and tender only, and the other for cars only, due mostly to Desdouit, Privat, Barbier and Petroff. The curves are distinctly different, the former tending toward a hyperbolic and the latter toward a parabolic form. The power developed by locomotives was taken from indicator diagrams and that required by the cars only from dynamometric measurements. He also shows the effect of varying rates of admission into the cylinders. At high speeds, viz., from 80 km to 100 km per hour, the air resistance is the largest part of the total resistance of the locomotive, and at these speeds the total resistance can be plotted by a straight line. He discusses the tests of the air resistance of cars only, as measured by a dynamometric car and gives Petroff's formula, which takes into consideration the number of cars as well as their weight, and speed, and applies their formula to certain examples taken from speed tests in Europe and America. He then combines Privat's locomotive formula with Petroff's car formula and plots out the resulting curves from the data already quoted and shows a very close agreement between the theoretical and determined values. To reduce the air resistance of trains, he recommends a hood for both front and rear cars resembling in shape somewhat that of the stern of a boat and the maintenance of vestibules between the cars.—*St. R'y Jour.*, May.

Larger Transportation Problems in Cities.—A recent lecture by Mr. Higgins on the subject is reprinted in the *Jour. of Frank. Inst.*, April and May, and *St. R'y Jour.*, May. In view of the fact that grave misunderstandings often arise between street railway companies and the public, an explanation is given of some of the different problems which the street railway manager has to solve and which are often misunderstood by the public. It is shown first that there is a wide difference between cities of different sizes, and laid out in different ways, as to the earnings and possibilities of profit, and that this often affects the concessions which a street railway company can make to the city. Elevated and underground railways are somewhat hazardous undertakings in competition with the high speed electric surface lines, since the latter will and must obtain the profitable short distance riding, leaving only the comparatively unprofitable longer rides to the elevated and underground railways, which are more or less difficult to get at. The problem of motive power is discussed at considerable length and it is shown that electricity has such great intrinsic advantages that it is improbable that it will ever be displaced to any large extent by other motive powers. The problem of cars and car service is, from the standpoint of the manager, one of obtaining a reasonable profit per car mile on every route in his system, and to do this he must guard against running cars at too long intervals or at too short intervals. Uniform and graded fares are compared, and their influence upon the city development is said to be in favor of uniform fare. It is also shown that gauged by the profits of the larger street railway companies of the United States, any material reduction from the five-cent fare commonly charged in America would be a serious if not a crushing burden upon the companies. Other subjects discussed are The Problem of Track and Roadbed, The Problem of Transfers, The Avoidance of Accidents, The Management of Employees, The Advantage of Combination of Different Roads in the Same City, and The Problem of Making a Fair Bargain With the City.—*St. R'y Jour.*, May. *Jour. Frank. Inst.*, April and May.

Legislation on the Electrical Industry in Switzerland.—Charles Rochat in the *Int. Ed. St. R'y Jour.*, for May, states that there are at present no uniform laws in Switzerland governing electrical installations, and the different cantons are as a matter of fact free to pass those rules which they judge most advisable. Recently the Government Postal and Railway Department appointed a commission to report on the most desirable methods of relieving the situation. Their report has not been made public, but it will form a basis for the proposed general code to cover the entire subject. This proposed law will be submitted to the Federal Chamber at its next session.—*St. R'y Jour.*, May, *Int. Ed.*

Emergency Brakes for Trailers.—A brief illustrated description is published in the *Elek Zeit.*, May 4, of a form of brake used in Germany on trailers, the object being to brake a car automatically if it should become detached from the motor car; it may also be used as an emergency brake and can be operated either mechanically by the conductor on the trailer or electrically by the motorman. In the device illustrated, a strap brake around a separate disc on the axle, is used, but the ordinary shoe brake, it is claimed, could also be applied in a similar way; the strap brakes are so arranged that the rotation tends to tighten them still more. The levers can be operated by a chain and crank on the car; they are also actuated by a coil through which passes a short circuiting current of the motor on the motor-car when it is acting as a brake. There is also another electromagnet which is always in circuit with the main current, and therefore releases its armature when this current is broken, as, for instance, when the trailer becomes detached; the release of this armature enables springs to apply the brakes; the leverage is so arranged that this magnet is required to exert but small power while the springs exert a great power, after the armature has been released; the armature is reset mechanically with the aid of a chain.—*Elek. Zeit.*, May 4.

Surface Contact System.—The Diatto system, which was illustrated and described some years ago, is being installed on the lines in the city of Tours in France, and a description of the whole plant is given in *L'Elec.*, April 29. The line was started in April and is

5-km in length; the portion of this which is in the city proper is provided with the surface contact system, while on the part in the outskirts the overhead trolley is used. It is stated that this first commercial application of the system is a very successful one. The system has already been described; it consists of an iron plunger floating in a mercury cup and attracted by the contact bar carried beneath the car, which at the same time is a magnet, drawing the plunger against the lower side of the contact plates. While ordinarily the magnets for operating the contacts are excited by the main current, a small storage battery is also used for the original starting or in case the current is interrupted; the contact is made between two carbon blocks and there is said to be no arcing there. A good illustration of the mechanism is included in the article. The same system has already been adopted for Lorient and for Reims, and it is to be used also on a line in Paris. Considering the rarity of the installations of the surface contact systems, this one, which appears to be a success, is of interest.—*L'Elec.*, April 29.

A longer and more detailed description of this plant, with more illustrations, is given in *L'Eclairage Elec.*, April 29.

English Tower Wagon.—The *St. R'y Jour.*, May, *Int. Ed.*, describes two types of English tower wagons. Their uses are threefold: First, to act as a crane to lift the poles, place them over the holes dug for them, and to lower them in position; second, as a platform for fixing the bracket arms of the poles; third, as a platform for the erection of insulators and trolley wires. The wagons have a windlass, geared so that one man can lift a pole weighing 1600 lbs. and lower it in place. One wagon illustrated has a collapsible platform for use under low bridges.—*St. R'y Jour.*, May, *Int. Ed.*

Heavy Snows in Montreal.—The *St. R'y Jour.*, May, publishes a letter from a railway manager in Montreal stating that when electric railways were introduced into Canada it was prophesied that snow would be an insurmountable difficulty, but this has not proven to be the case. The snow after a recent storm in March was so hard that it would bear a man's weight, but was removed by a rotary snowplow equipped with four 50-hp motors. The Montreal Belt Line Railway Company has twelve miles of track, and the depth of snow last winter varied from 2 ft. to 10 ft.—*St. R'y Jour.*, May.

REFERENCES.

Street Railways in Germany.—Some statistical data concerning electric railways in Germany.—*Elec. Tech.*, April 30.

Third-Rail System.—A brief communication discussing chiefly the question of leakage currents and giving some data.—Baillard. *Eng. News*, May 11.

Electric Automobiles.—The beginning of an article of a general character.—Schmitt. *L'Elec.*, May 6.

Submarine Boats.—The beginning of an article giving a list of those used by different countries, accompanied by some brief descriptions.—Marcillac. *L'Eclairage Elec.*, May 6.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Puenmatic Interrupter for Accumulators.—An arrangement devised by Petersen for disconnecting a battery of accumulators from the charging circuit when it has been fully charged, is described in the *Elek. Zeit.*, May 4. One of the cells is sealed and has attached to it two mercury manometer tubes which have platinum wires fused through them at two places so that a change of level of the mercury columns will break the circuit after the air pressure due to the gases has exceeded a certain amount. The apparatus is said to have been in use in a laboratory for some time, with very good results. There is also in circuit an electromagnet through which the discharging current passes, and this magnet opens a valve so as to release the air pressure; the second mercury tube operates this electromagnet; when the air pressure has been released the apparatus is automatically set for charging again.—*Elek. Zeit.*, May 4.

REFERENCES.

Theatre Lighting.—A long profusely illustrated description of the lighting of Covent Garden Theatre, which is practically the only opera house in London.—Lond. *Elec. Eng.*, May 5.

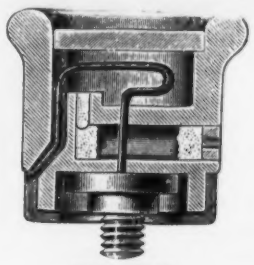
Munich.—A brief description, without illustrations, of the present condition of the station.—*Elec. Tech.*, April 30.

Switchboard Design.—Descriptions of some points to be attended to in switchboard designs.—Lond. *Elec. Eng.*, May 5.

Municipalities Owning Electric Works.—An extract from *Municipal Affairs*, December, of an extended article on municipalities owning gas and electric works, both in this country and abroad.—Maltbie. *Prog. Age*, May 15.

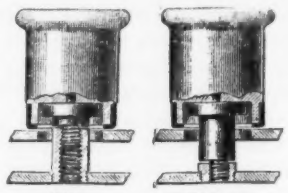
WIRES, WIRING AND CONDUITS.

New System of Fuses for 250 Volts.—A paper by Mr. Dressler on a new system of fuses complying with the German requirements, is reprinted in full in the *Elek Zeit.*, May 4, with a number of illustrations. They were designed chiefly for use on 250-volt incandescent light circuits, as the ordinary fuses are not safe for such voltages. Moreover, the fuses are arranged so that they can not be interchanged, as only a fuse for a certain current will fit the receptacle into which it is screwed. The fuse is shown in cross-section in the



NEW FUSE.

adjoining figure, the case being made of porcelain, as that was considered to be the only safe material. As will be seen, the fuse wire is not long, but the arc is controlled by the fact that the fuse wires pass through two air chambers; the wire is so divided in these two chambers that it will melt in the upper one first, at which time it will be nearly melted in the lower one; the air in the upper one will become heated and expanded so as to cause a current of air in the lower one which is sufficient to blow out the arc, as it communicates with the air; the communicating canals are filled with loose asbestos which will allow the air but not the flame to pass through. For the material of the fuse he prefers pure lead, and he recommends that for the sake of uniformity all fuse wires should be rated by the current which will fuse the wire in the fifth second. These fuses are readily made for as much as 500 volts, in which case, however, three air chambers are necessary. To prevent the wrong fuses from being inserted, the flange which is above the screw thread is made of various lengths corresponding with certain currents and the sockets into which they are screwed are also of different lengths, as shown



FUSE SOCKETS.

in the two other illustrations, the left hand one of which is for 4 amperes and the other for 30; it will readily be seen that neither could be screwed into the socket of the other and make contact at both places. Not only is it impossible to insert a larger fuse than the one for which a socket is intended, but it is also impossible to insert a smaller one of more than one step smaller. He then describes in detail, with illustrations, the various forms of cutout blocks for which these fuses are used.—Dressler. *Elek. Zeit.*, May 4.

Interior Conduits.—The Lond. *Elec. Rev.*, May 5, contains several communications discussing the subject of interior conduit wiring. Mr. Isherwood gives the results of some years experience. If the absolutely best installation is required irrespective of cost, then he claims the steel-armored conduit has no competitor; he thinks it doubtful, however, whether the very great extra outlay is counterbalanced by the advantages, and believes a really well installed bare pipe system cannot be improved upon very much. With a careful workman the advantages are in favor of the insulated conduit. Any good installation should have no joints in the wire at all.

Mr. Burchell believes that insulated pipes are quite unnecessary except for outside use. He does not believe in relying on an insulated pipe for insulation, but to use a highly insulated wire. He compares the insulated iron pipes with the simplex system. Mr. Owen also discusses the latter system which he praises very highly.—Lond. *Elec. Rev.*, May 5.

REFERENCES.

Calculation of Wiring for Incandescent Lamps.—The first part of a mathematical article in which he discusses the correct calculations

of wiring. He claims that the wiring should satisfy the three following conditions: The voltage should not vary more than 2 per cent.; the temperature of the conductors should not rise more than 10° C. above that of the surrounding atmosphere; the cross-section should be such as will give the greatest economy. No conclusions are given in the present portion.—Vallee. *L'Elec.,* May 6.

High-Voltage Fittings.—Brief illustrated descriptions of fittings for 230-volt lamp wiring.—Lond. *Elec. Rev.,* May 5.

ELECTRO-PHYSICS AND MAGNETISM.

A Cathodic Rectifier.—Villard has shown that at a given pressure the resistance of a vacuum tube depends on the diameter of the cathode stream. In the present paper he makes use of this for constructing a rectifier in which one electrode is a coil of wire, while the other ends in a small disc and is enclosed in a separate tube with a small opening on the side toward the coil. Cathode rays are freely developed at the coil, but encounter a great resistance when the small disc is made the cathode; the spark lengths corresponding to the two resistances are 1-mm and 150-mm respectively. The rectifier is not perceptibly heated. A Wheatstone bridge arrangement of four rectifiers, enables both oscillations of the alternating current to be utilized. —Villard. *Comptes Rendus,* April 17; abstracted briefly in Lond. *Elec.,* May 5.

Dimensions of Cathode Particles.—An attempt to estimate the size of the cathode particles based on the disruption by layers of gas. The author finds that to satisfy experimental data the size of X-ray particles would have to be considerable below zero, which means that there are no such particles, and the rays must represent some disturbance of the ether.—Guglielmo. *Nuovo Cimento,* February; abstracted with some equations in the Lond. *Elec.,* May 5.

REFERENCES.

Formation of Cathode Rays.—A long illustrated article on the peculiarities of the flux of rays, their emission and propagation; the resistance of the tubes and the nature of the radient material. In connection with the latter he expresses the opinion that the projected particles in these rays are electrified molecules of hydrogen.—Villard. *Rev. Gen. des Science,* April 30.

Resistance and Inductance to Oscillatory Discharge.—A mathematical article in which he modifies the analysis published by Lord Rayleigh so as to include the decaying periodic currents obtained in discharging the condenser and also the cause of the dampened trains of high frequency waves generated by a Hertz oscillator. He discusses the equivalent resistances and inductances of the wire to an oscillatory discharge.—Barton. *Phil. Mag.,* May.

High Frequency Disruptive Discharge.—When a spark gap is in parallel with a condenser in the secondary circuit of a high voltage transformer, a strong current produces a flaming discharge which possesses interesting properties; these he discusses.—Abraham. *Comptes Rendus,* April 17; abstracted briefly in Lond. *Elec.,* May 5.

Electrostatic Capacity of Two Wires in Parallel.—A short mathematical paper in which he deduces formulas in a different way than with those published by Blavier, which makes the calculations much simpler.—Pomey. *L'Eclairage Elec.,* April 29.

Network of Conductors.—A short mathematical article on the electrostatic theory of conductors in an insulated medium. Maxwell's theory leads to two results which the present author generalizes.—Pomay. *L'Eclairage Elec.,* May 6.

Absorption of Hertzian Waves by Non-Magnetic Bodies.—A reprint of an Academy note.—Branly and Le Bon. *L'Elec.,* May 6.

Theory of the Zeeman Effect.—A brief abstract of an article by Goldhammer in the *Wied. Ann.* No. 3, in which is offered a new theoretical explanation of this phenomenon. He considers that what are usually called the constants of the medium, like the specific resistance or the dielectric constant, are really not constants, but are functions of the wave frequency.—*Science,* May 5.

Alloys of Iron and Nickel.—A paper by Mr. Hadfield was read before the Institution of Civil Engineers on this subject on March 28. Among the other qualities of this alloy he dealt also with the magnetic and electric qualities. No further information is given concerning these qualities in the abstract published by that society.

Magnetism.—The conclusion of Prof. Ewing's lecture, see Digest, May 20. He discusses the subject of hysteresis, permeability, etc., giving illustrated descriptions of his hysteresis meter, his permeability bridge and his magentic balance. In conclusion he also refers to his well-nown model illustrating magnetism and hysteresis. —Ewing. Lond. *Elec.,* May 5.

Magnetic Susceptibility of Water.—Further determinations of the values.—Jaeger and Meyer. *Wied. Ann.* No. 3; abstracted briefly in Lond. *Elec.,* May 5, and *L'Eclairage Elec.,* May 6.

Effect of Temperature on Magnetization.—Descriptions of experiments made to measure the effect of temperature and of circular magnetization on longitudinally magnetized iron wire. The specimens were heated by a platinum tube surrounding the iron and also by passing th current through the iron wire itself.—Pitcher. *Phil. Mag.,* May.

ELECTRO-CHEMISTRY AND BATTERIES.

Carbide of Calcium Plant at Meran.—A long illustrated description of this plant, the first in Austria, is given by Keller in *L'Eclairage Elec.,* May 6. Water power is used and the original station has five three-phase alternators of 1200-hp each, directly coupled to the turbines; this power is transmitted at 10,000 volts, and about 2000 of it is used for the manufacture of the carbide by the Gin and Leleux process. In the concluding portion he gives detailed figures of the cost of production at that plant, claiming that the results obtained in Europe are much better than those of the American plants. Such efficiencies as 6 to 7-kg per morse-power per day, are purely imaginary, as 2.5-kg (5.5 lbs.) would be quite satisfactory. Theoretically it requires 875-kg of lime and 562 of carbon to produce a ton of the carbide; in practice, however, 940 and 650 respectively are required. The cost of a ton of lime at that factory is about $4 and of the carbon about $8. One electrode will be sufficient for 10 tons of the carbide, and it costs $33, or $3.30 per ton. The electrical energy per ton of the carbide is 6400-hp hours, which at $10 per electrical hp-year is equal to a little over $9 per ton. The accessory machinery, the loss in the lines, etc., corresponds to about 200-hp or about $1 per ton, the production of that factory being about 6.5 tons per day. Labor at 70 to 80 cents per day amounts to about $3.70 per ton. Amortization amounts to about $5 per ton and the general expenses to about $5 per ton; the maintenance of the plant is given as $1.50 per ton. The total cost at that factory is $36.20 per ton.—Keller. *L'Eclairage Elec.,* May 6.

Energy for Producing Calcium Carbide.—In a short article by Gin in *L'Eclairage Elec.,* May 6, he calculates the theoretical amount of energy required to produce a given weight of carbide of calcium. He assumes that the reaction takes place at a temperature of 3300° C. The quantity of heat necessary to raise one molecule (presumably 56-gr) of oxide of calcium and three atoms of carbon to 3300° C. is 97,000 calories; the total will be 212,000 calories for forming one molecule (64-gr) of the calcium carbide; this is equal to 245.5 watt hours or 3837 kw-hours for the production of one ton of the carbide; adding to this 10 per cent. loss at the electrodes, etc., gives 4260, which corresponds to a production of 5.563-kg of carbide per kw-day. Comparing this with the figures obtained in the installation at Meran in Austria (see abstract above), namely, 5.2-kg per kw-day, shows an efficiency of 92 per cent.—Gin. *L'Eclairage Elec.,* May 6.

Sterilization of Water by Ozone.—Mr. Andreoli, in the Lond. *Elec. Rev.,* May 5, discusses the subject and describes some experiments. He claims that the sterilization of drinking water is the most important application of ozone. He refers to a report on some experiments carried out at Lille, which are remarkable from the bacteriological point of view, showing that ozone is a most powerful microbicide. Some conclsiuons from the report are quoted; one of these is that sterilization is thought to be quite sufficiently accomplished with ozonized air having a concentration of five to six milligrams of ozone per liter; another is that ozone does not add any foreign elements which are detrimental to the health. Water submitted to this treatment is less liable to ulterior pollution; the water is strongly ærated without losing any of its useful mineral elements and is rendered more healthy and more palatable. The report does not state how many liters of air were required per hour for a given mass of water. He then refers to his own experiments which he has been conducting for some months, and in which he determined the watt hours required for given quantities of different waters. He could not treat more than 440 gallons at a time; the voltage of the primary circuit was between 40 and 60 and the current between 3 and 5 amperes; the voltage in the secondary does not exceed 3500. The water was artificially contaminated with sewage and cultures, and was therefore much more difficult to purify than the usual river water. The results giving the watts per gallon and the number of microbes before and after are given in a table, and he considers that he did not require more than an average of 140 watt hours per cubic meter of water, which is not too much polluted; he thinks that with larger apparatus that the purification and sterilization of water can be effected at the rate of 100 watt hours per cb.m. (220 gals.), or 2200 gallons per kw hour.—Andreoli. Lond. *Elec. Rev.,* May 5.

Electrolytic Preparation of Hydrogen and Oxygen.—In an article in *L'Industrie Electrochemie,* abstracted briefly in *L'Eclairage Elec.,* April 29, it is claimed that there is no prospect of the industrial development of this method unless applications are also found for the hydrogen; at present the oxygen only is of value. By means of the liquefaction of the air by the Linde process, the oxygen of the air may be obtained separated from the nitrogen, at a cost of only a sixth of a hp-hour per cb-m., which reduces the cost of a cb-m. of oxygen to a fraction of a cent, and it will be difficult for the electrolytic process to compete with this. All the electrical processes may be divided into two classes in one of which the two gases are disengaged separately and simultaneously, while in the other the generation of hydrogen is avoided by depolarization or by means of metallic deposits on the cathode as, for instnce, from copper solutions, but these methods have not given favorable results. Another method is to use electrodes of oxide of copper which are regenerated by the oxygen of the air, but this, too, was not a success. The only method left is to generate both gases; in all the processes for doing this, the electrodes are of iron and the electrolytes are alkaline solution. The Garuti and the Schuckert processes are the only ones in use in practice, the former being used in a number of cities and the latter at Hanau, Germany.—*L'Eclairage Elec.,* April 29.

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Diffusion Through Ferro-Cyanide Membranes.—An article in which he shows that for a given membrane, the substances which are blackened by it have higher molecular weights than those which pass through it; generally the lower the molecular weight the higher the capacity of passage.—Naccari. *Nuovo Cimento,* 8, p. 260; noticed briefly in *Science Abstracts,* March.

Electrolytic Analyses.—A brief discussion of a recent article by Avery and Dales on determining the impurities in iron by analyzing it electrolytically. The present author points out the difficulties and the causes of errors.—Arth. *L'Eclairage Elec.,* May 29.

Accumulator Construction.—The conclusion of the very long series of notes. Data is given for several different forms of accumulators. —FitzGerald. Lond. *Elec. Eng.,* May 5.

Calcium Carbide Patent.—A discussion of the priority of invention of the electrical process. The recent interference in the United States Patent Office between Bulli r and Willson has been decided against the latter.—Boehm. *Prog. Age,* May 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Wehnelt Interrupter.—Several French Academy papers on this interrupter are abstracted briefly in *L'Eclairage Elec.,* April 29. Le Roy studied the effect of an increase or diminution of the atmospheric pressure and found that a diminution of the pressure tends to stop the phenomenon of interruption and that an increase of pressure has the same effect. (This does not agree with a statement of S. P. Thompson, who found that the current increased with the pressure. Carpentier (abstracted in the Lond. *Elec.,* May 5) endeavored to adapt the interrupter to lower voltages. Unless the voltage is high enough, the interrupter will act like an ordinary cell evolving hydrogen at the cathode and oxygen at the anode, but he found that the voltages reuired for producing interruptions varied greatly with the temperature. He heats the liquid to 80 or 90 or even 100° C., at which it will interrupt the current with only a few secondary cells. After it has once been heated it maintains itself at the proper temperature if it is surrounded by thermal insulators. The acid gases evolved are collected over an alkaline bath. He also added another improvement by means of which the length of the projecting platinum wire can be altered so as to adapt the apparatus to various conditions.

Armagnat (abstracted in Lond. *Elec.,* May 5) offers an explanation of the action of the interrupter. By means of an Abraham rheograph he found that the primary current is not oscillatory, that is, that it does not change its direction and therefore the electrolytic capacity should not be used to explain the phenomenon. He believes that the most plausible explanation is that there exists at the contact of the anode and the electrolyte a resistance which increases rapidly with the temperature, and that the energy expended at the surface of contact rapidly heats the anodes and the neighboring liquid and vaporizes it; when the temperature is sufficiently high there is formed an envelope of the vapor whose resistance is infinite, and the current is therefore interrupted. The gas set free as the anode is a mixture of hydrogen and oxygen. An examination with the spectroscope shows that the gases alone are incandescent, the incandescence being due to the spark, as it increases with the self-induction of th spark. When the interrupter operates, it was found that the incandescence disappears entirely. He gives a formula for the current which shows that the current induced in the secondary is simply proportional to the coefficient or transformation of the coil, that is, approximately to the ratio of the number of turns in the two coils; for a given coil the voltage is increased by decreasing the number of turns of the primary, that is, by diminishing the self-induction of that circuit, but the e. m. f. does not vary if the self-induction is increased or diminished by changing the magnetic resistance of the coil, leaving the number of turns the same. He explains the re-establishing of the current by the fact that the gases leave the surface of the anode, thus allowing the anode to come into contact with the liquid. He considers that it is not safe to assume that the vapors are dissociated. The current is always proportional to the voltage including that of self-induction, and inversely proportional to the resistance including that of contact at the anode; the latter is a complicated function of the current, intensity, temperature and time; it is also inversely proportional to the surface of the anode. The moment at which the current begins to decrease is reached sooner, the greater the voltage and the smaller the area. The resistance increases with the temperature.—*L'Eclairage Elec.,* April 29.

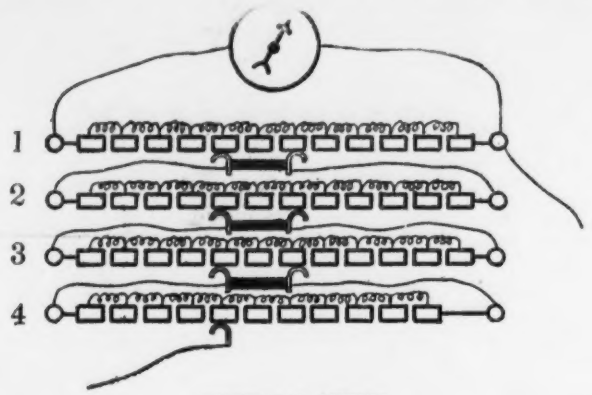
According to the Lond. *Elec. Rev.,* May 5, Mr. Marchant found the multipolar tube to be the most useful; the anodes were six in number and were made of 18 mill platinum wire projecting one-twentieth of an inch. He also found it better to pass the wire through an ebonite plug at the bottom of the glass tube instead of fusing it into the latter. He found that the interrupter fatigued quite rapidly, which was due to the acid getting hot, but this can be readily overcome.

Mr. Satori, in the *Zeit. fuer Elek.,* April 30, describes some researches with the alternating current. Instead of the platinum wire in the glass tube he uses a copper wire passing through a rubber tube and so arranged that the projecting end may be adjusted or the wire moved as it becomes worn off. He considers that it is necessary to cool the liquid, as the interruptions will take place only when the temperature of the solution is far below its boiling point.

In *Cosmos,* April 29, Mr. Tommasi describes some early experiments in similar califorics and light phenomena produced by electrolysis.

Capacity Measurements of Long Submarine Cables.—A reprint of an Institution paper by Mr. Young is begun in the Lond. *Elec., Elec. Rev.* and *Elec. Eng.,* May 5. He gives a summary of researches in this intricate problem and some conclusions concerning important questions connected with submarine cables. He shows with the aid of a diagram what happens when a long cable has its distant end insulated and is charged continuously. The *Elec. Rev.* comments very favorably on the paper, editorially, claiming that it is of great interest and practical utility. The test which the author recommends is more satisfactory than either the Thompson or the Gott method; it is practically a combination of both of them; the principle of mixing the charge is used and the connections are those of the Gott test, only that the galvanometer key is closed during the charge and both leakage and absorption are balanced by observation and adjustment during charging; the slide contact at the start is adjusted so that the two branches bear the same ratio to each other as the cable capacity, as obtained approximately by a preliminary experiment. The condensers are then shunted by a suitable resistance which is adjusted until the galvanometer shows a balance with the apparent dielectric resistance of the cable after any desired time of charge, and during this test the galvanometer key is closed. Having thus charged and balanced the apparent dielectric resistance of both the condenser and the cable, the rest of the test is the same as the Thompson, that is, the charges in the cable and condenser are mixed and the presence of any remnant charge in either is determined by connecting the junction of the two capacities through the galvanometer. It is thought that the false zero method would obviously be used. The test requires no specially constructed key. Examples show that the results are remarkably satisfactory and that practically the same value is obtained for wide differences of time of charge and dielectric resistance without having to calculate allowances for leakages. It is thought editorially that for simplicity and uniform results the method leaves little to be improved upon. He suggests 30 seconds as a reasonable time for making the measurements in the case of a lead cable, but for a coiled cable of 300 to 400 miles, two minutes is not excessive.—Young. Lond. *Elec., Elec. Rev.* and *Elec. Eng.,* May 5.

Sullivan's Universal Shunt.—A brief description of a special form of universal shunt of the Ayrton-Mather type is illustrated in the Lond. *Elec. Rev.*, May 5, the object of which is to obtain a very fine degree of subdivision. The shunt is shown diagramatically in the adjoining figure and the adjustments will be seen are made with



UNIVERSAL SHUNT.

sliding contacts over four rows of coils, the first containing 11 coils of 1000 each, the second 11 of 200, the third 11 of 40, and the fourth 10 coils of 8 ohms each; all but the lower sliding contact bridge over two coils which are thus in parallel with all the coils of the next lower set. The principle is that a derived circuit or another derived circuit; each of the 1000-ohm coils can thus be subdivided into 10 equal parts by the second row, into 100 by the third, and into 1000 by the fourth; the shunt therefore reads differences of one ohm. To find the multiplying power of any shunt the reciprocal of the shunt readings is taken. The same shunt box can also be used as a proportional bridge in resistance measurements; it can also be combined to advantage with a high resistance coil.—Lond. *Elec. Rev.*, May 5.

Induction Coil Voltages.—In a previous article by Oberbeck he showed that the difference of potential at the secondary terminals is approximately proportional to that of the primary. He continues the discussion in an article in the *Wied. Ann.*, April, 1898, which is abstracted at some length with diagrams in *L'Eclairage Elec.*, April 29. The resistance of the primary circuit has only a small effect on the ratio of the two differences of potential; the principal factor is the primary current at the moment of rupture, and therefore the speed of the interruption; this current density depends on the time during which the circuit is closed. He gives a formula for the current and shows that the ratio of the differences of potential is smaller as the resistance of the primary is greater; there is an advantage in diminishing the resistance of both. Much greater voltages can be produced with a double interrupter or a revolving one which is turning slowly. A number of formulas are given. He also determined what voltages were necessary for obtaining sparks of various lengths; the curves are reproduced in the abstract; he found that the voltage between a positive point and a conductor was 45,000 for 10-cm and 75,000 for 20-cm, from which he deduces that it would require 200,000 volts for a one-meter spark. He considers that the discharge by a spark and a brush discharge are two distinct phenomena.—Oberbeck. *Wied. Ann.*, April 1898; abstracted briefly in *L'Eclairage Elec.*, April 29.

Action of the Induction Coil Condenser.—Dubois made some researches which are described in the *Wied. Ann.*, April, 1898, and briefly abstracted in *L'Eclairage Elec.*, April 29, in which he made systematic investigations of the current strength by means of an electric-dynamometer. He found that connecting the condenser with the primary coil as usual, increased the current in the secondary to about double the value which it would have without the condenser; on increasing the capacity, the current reaches a maximum and then falls again; the amount of the capacity corresponding to this maximum point is smaller as the total distance of the secondary circuit is greater; it is also much smaller when the soft iron core is inserted into the core.—Dubois. *Wied. Ann.*, April, 1898; noticed briefly in *L'Eclairage Elec.*, April 29.

Measurement of High Resistances.—Mr. Benecke, in the Can. *Elec. News*, May, claims that high resistances may be measured up to a thousand megohms by the Wheatstone bridge to a greater accuracy than by the ordinary detection method by simply measuring this high resistance in multiple with another resistance. He illustrates it with an example. (This is incorrect, however, as he does not really measure it more accurately, but simply obtains some figures from which he calculates the results to an absurd number of figures which are not warranted by the degree of accuracy of the test.)—Benecke. Can. *Elec. News*, May.

REFERENCES.

Phenomena in Induction Coils.—A paper by Walter is abstracted in *L'Eclairage Elec.*, April 29. He deals with the theory of such coils.. He concludes that there is an advantage in the construction of large coils, in diminishing as much as possible the capacity of the secondary, and also to use a core of great permeability and little hysteresis. His researches are said to be extremely interesting and show that coils have heretofore been constructed on a purely emperical basis; he believes that it would be found to be an advantage to design them more rationally.—Walter. *Wied. Ann.* 66, p. 623; abstracted in *L'Eclairage Elec.*, April 29.

Oscillations Produced by the Ruhmkorff Coil.—An abstract of an article from the *Comptes Rendus*, 128, p. 420, on electrical oscillations produced by such a coil when the secondary is open and on a new method of measuring capacities. When such a coil has its secondary circuit opened, Geissler tubes in the neighborhood will become illuminated, showing the presence of oscillations. This leads to a method of measuring capacities which do not exceed a fraction of an electrostatic unit, that is, of very small capacities.—Borgman and Petrowsky. *L'Eclairage Elec.*, May 6.

Researches With an Induction Coil.—Kerr discovered some time ago that dielectrics between the armature of a condenser became doubly refracting. In the present article the author uses this phenomena for studying the differeneces of potential of short duration or those which vary with the time.—Hess. *Wied. Ann.*, December, 1898; abstracted in *L'Eclairage Elec.*, April 29.

Five-Cell Quadrant Electrometer.—A description of an instrument designed by the author. There is a combining system of five needles and the suspended system is dampened magnetically, the damping being adjusted by moving the iron core in the copper cylinder. Measurements can be made with an accuracy of 1 part in 1000. —Haga. *Proc. Roy. Acad. of Sciences*, Amsterdam, June 25, 1898; abstracted briefly in the *Phil. Mag.*, May.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Hughes' Early Researches in Wireless Telegraphy.—An interesting account is reprinted in the Lond. *Elec.*, May 5, of the early work of Prof. Huges (inventor of the microphone), in wireless telegraphy by means of etheric waves; it appears to be the first published account of his experiments which were made in 1879. He was experimenting with his microphone and induction balance, and found that the microphone produced a sound in the receiver even when it was placed several feet distant from the coils through which an intermittent current was passing and not in any other way connected. He found that the whole atmosphere, even in several rooms distant from there, would be invisibly changed and that this could be noticed with a microphone and telephone receiver. He experimented on the best form of receiver for these invisible electric rays, which he found would pass over great distances through walls, etc. He found that carbon contacts or a piece of coke resting on bright steel, were very sensitive and self-restoring receivers. A loose contact between metals, while equally sensitive, required restoring. He also used the microphone as a relay in detecting such rays. He endeavored to discover the best receiver so as to utilize such waves for the transmission of messages. He showed his experiments to a number of well-known physicists at that time. The distances were 60 ft. in the building, but he also took the instrument on the street, and walked away from the transmitter, obtaining signals up to 500 yards. He claimed the existence of the waves at that time, but was unable to convince others of their presence. He also calls attention to still earlier experiments of Prof. Henry, of Princeton (U. S.), which were published by the Smithsonian Institute, Vol. 1, p. 203, the date being probably about 1850; he magnetized a needle in a coil 30 ft. distant; also by a discharge of lightning 8 miles distant.—Hughes. Lond. *Elec.*, May 5.

Theory of Wireless Telegraphy.—An abstract of a French paper by Prof. Blondel on theory of what he calls "the Antennæ," that is, the vertical conductors in Marconi's system, is published in the Lond. *Elec. Rev.*, March 5. The principal effect he attributes to an oscillating system, in which the capacity of the transmitting antennæ and the earth form the two plates of a condenser which is charged by a coil and becomes the seat of an oscillating current when the spark passes over the gap. The direct radiation from the antennæ to the earth is very intense, but is quick-damped out, and this he believes is the reason why it has been found impossible so far to establish

resonance between the transmitting and the receiving antennæ. The capacity of the antannæ will probably determine the length of the waves; the latter is sufficiently great relatively to assume that the oscillating current in the conductor is approximately the same as in the wings of the Hertzian oscillator. The function of the transmitting antenna is to regulate the intensity of the centre of disturbance by increasing the volume of ether disturbed and also to direct the magnetic lines in the direction which will produce the maximum effect on the parallel antenna of the receiving station. When the two wires are horizontal instead of vertical the nearness of the earth induces a disturbing influence and the vertical ones are therefore greatly to be preferred. He reduces this problem to that of the Hertz oscillator.—Blondel. Lond. *Elec. Rev.*, May 5.

Pacific Cable.—The report of the committee appointed in 1896 is briefly referred to in the Lond. *Elec.*, May 5. The committee recommends the route from Vancouver via Fanning or Palmyra Island, to Fiji and Norfolk Island, branching from there to Queensland and New Zealand. The length would be about 8000 nautical miles and the longest section, the first one, 3560 knots. With a core of 550 lbs. of copper and 380 of gutta percha, for the longest section, giving a speed of 40 paying letters per minute, it is estimated that the cost of the cables with a 10 per cent. slack will be $7,500,000. The total annual expenses, including amortization, would be about $700,000; the probable income is also estimated. It is recommended that the cable should be owned and operated by the governments; a duplicate cable is also recommended. The report is briefly commented on; it is thought that 10 per cent. slack is not enough for places which may exceed 3000 fathoms; it is quite an assumption to estimate that there would be so much traffic in competition with the other cables to Australia which are working at much higher speeds. No mention is made of the volcanic nature of much of the bed of the Pacific Ocean. —Lond. *Elec.*, May 5.

Submarine Telephone.—A brief illustrated description of a novel idea of an Italian named d'Asar is given in *Cosmos*, May 6. The device is intended to enable ships to hear the noise of the propellor of a neighboring ship. It consists of two sets of telephone transmitters which are sunk in the water several meters below the ship; each one consists of a number of transmitters pointing in different directions. These are connected with receivers on board the ship and from the direction in which the sound is transmitted through the water, is loudest, the position of the ship will be indicated. It is said to be possible to thus hear a vessel six miles distant. (It would not indicate the presence of a steamer which is not in motion, nor a sailing vessel.)—*Cosmos*, May 6.

New Electric Bell System.—A brief illustrated description of a system used in Germany in which there is only one vibrator, placed near the battery in the main circuit, for interrupting the current, the bells being made without a make and break, consisting simply of the magnet, its armature and the bell. The advantages are evident.—L'Elec., May 6.

REFERENCES.

The Combination of Double and Single Wire Telephone Circuits.—A brief illustrated description of a method for communicating directly between a double circuit, that is, a metallic circuit, and a single wire circuit. It enables the two outer stations to communicate with each other and call each other without calling the intermediate one. They can both also call the one between them.—Vallance. *Jour. Telegraphique*, April 25.

MISCELLANEOUS.

Electric Light Baths.—A brief abstract is published in the Lond. *Elec.*, May 5, from a British medical journal, on the subject of heat and light baths, in some of which incandescent lamps are used as the thermal generators, special advantages being claimed on the ground that the heat emitted from a light source is radiated rather than conducted, and therefore has a more beneficial effect. One of these incandescent light baths is illustrated; it consists of a wooden box with hinged sides and lamps opposite mirrors; the patient enters this nearly closed box. The treatment is said to have been found useful for rheumatism, asthma, anæmia, neurasthenia and obesity. The radient heat is said to permeate the tissues very deeply and the effect is more stimulating. The perspiration is more quickly induced and the comparative coolness of the air is an advantage. It seems uncertain whether the light emitted plays an important part. Some references are also made to the experiments of Dr. Cleves on the therapeutic action of arc lamps, but more extended obsrvations are required. Several writers have noted that either the light, the ozone or the vapors emitted by arc lamps are a very good disinfectant and have a deodorizing action on noxious smells; thus an arc lamp in a dark basement near offensive places dissipates all bad odor completely.—Lond. *Elec.*, May 5.

Consumption of Copper.—According to a consular report noticed briefly in the *Eng. News*, May 11, the consumption of copper in 1898 amounted to over 400,000 tons, the United States, England and Germany using 115,935, 106,000 and 101,518 tons respectively, chiefly for electrical installations. The world's production in that year is estimated to be 420,000 tons, of which 234,272 came from the United States.—*Eng. News*, May 11.

New Books.

SMALL ACCUMULATORS. How Made and Used. Edited by Percival Marshall, A. I. M. E. New York: Spon & Chamberlain. 80 pages, illustrated. Price, 50 cents.

This is essentially a book for amateurs, and as such is a very creditable production. It contains as much information, both theoretical and practical, as could well be put within the limited space, and what is more important, the information is nearly all authentic. There are, however, one or two slips, as, for example, on page 78, where a process for insulating copper, brass and iron is given, consisting in coating those metals with peroxide of lead. The insulation is said to be "absolute." A coating of peroxide of lead, when dry, is a long way from being a good conductor, but it is going a little too far to call it an absolute insulator. Again, in describing an accumulator of 32 ampere-hours capacity, it is said that the accumulator will supply a current of 1 ampere for 32 hours, or 4 amperes for 8 hours, and so on. This statement is evidently intended for the benefit of the uninitiated, to impress upon them the meaning of the term ampere-hour, but in impressing this point, another important point is passed over, namely, the fact that the ampere-hour capacity of any cell, but more especially such as are described in the text, decreases considerably with the increase of discharge rate.

The book gives directions for making two different sizes of cells and a process for forming which is more expeditious than the ordinary process with pasted plates. Full directions are given for the charging and care of accumulators, and a number of amateur uses for them are described. The advantages of accumulators over primary cells, where heavy currents are required, are so great that they are coming more and more into use, for amateur as well as for industrial purposes, and Mr. Marshall's book is a very good one for amateurs to read.

THE STEAM ENGINE INDICATOR. Compiled From the Regular Issues of *Power*. With revisions and extensions comprising numerous tables. New York: Power Publishing Company. 208 pages, 147 illustrations. Price, $1.50.

This handy reference book for the stationary engineer contains nineteen chapters. Among the subjects treated are the selection and care of indicator; the various reducing motions and their application to the instrument; the indicator diagram, including the ideal diagram and the departures found therefrom in usual practice; several chapters forming a study of the admission, steam and expansion lines, the point of release, back-pressure and compression lines; the measurement of the diagram for mean effective pressure; the planimeter and the computation of horse-power; mean effective pressure and point of cut-off by compression, and the computation of steam consumption from the diagram; two chapters on diagrams from compound engines, showing both clearance neglected and clearance considered.

One entire chapter is devoted to a discussion of errors in the diagram, including those resulting from the use of the pendulum motion, from a lever of fixed length vibrating 90 degs., from the same lever vibrating 35 degs., the amount of error allowable, the error from lack of parallelism between cord and guides, and the error due to indirect connection of indicator.

Ten tables are given in the book: A pantagraph table, a table of horse-power constants and one of mean effective pressures for various cut-offs under conditions of ideal diagram; tables of hyperbolic logarithms and actual ratios of expansion; two tables give the steam accounted for by the indicator. Concluding the book are nearly twenty pages of tables giving the properties of saturated steam, the diameters of circles, their circumferences, areas, squares, cubes, square roots and cube roots. The book concludes with a comprehensive and well-arranged index.

TELEGRAPHIC CODE. Specially adapted for the use of Financiers, Merchants, Shipowners, Brokers, Agents, etc. (American Edition). By W. Clauson-Thue, F. R. G. S. Fourth Edition. New York: The American Code Publishing Co. 480 pages. Price, $5.00.

This standard work has no less than 25,388 sentences or phrases fitted with code words and numbers. Thus, the phrase "Charterers insist upon holding an inquiry" is given on a line with the group 7285 and the code word "ineptitude," so that either the group or the word may be used to represent the phrase. None of the code words have more than ten letters, in accordance with cable telegraphic rules. The book has evidently been prepared originally for the British public and has received a few additional phrases to suit American users. The system of indexing is very good, and the time in looking for a code word seems to be reduced to a minimum. About 700 additional code words are introduced at the end of the book without attached meanings, for special use by convention between users, and means are given for making cipher codes when desired. An example of a message is given which, when written out in full takes 87 words, but which when coded takes only 17. An appendix is given explaining code time. The book has undoubted merit for convenience and completeness, but more closely conforms to the requirements of the British than of the American man of business.

MUNICIPAL MONOPOLIES. Edited by Prof. E. W. Bemis. New York, 1899: Thomas Y. Crowell & Co. Cloth, 12mo. 691 pages. Price, $2.

This is a very interesting collection of papers by American economists and specialists. It includes sections on water works by M. N. Baker, of the *Engineering News;* municipal electric lighting, by Prof. J. R. Commons; the latest electric lighting reports, by Prof. Bemis; the validity of electric light comparisons, by Dr. F. A. C. Perrine; the telephone, by Mr. Frank Parsons; the municipal franchises in New York, by Mr. Max West; legal aspects of monopoly, by Mr. Parsons; street railways, by Prof. Bemis, and gas by the same, who also contributes a general summing up on the broad question of regulation or ownership. The book may fairly be said to present the views in general of the extremists who favor municipal ownership, and bristles with their arguments, tabular, rhetorical and otherwise. Mr. Baker does not hold a brief for municipal water works or against them, but believes in them as good practice. Dr. Perrine views his topic rather from the lighting standpoint than as one of economics. As to telephony, Mr. Parsons thinks that if the United States had municipal exchanges and government toll lines, it would be as well telephoned as any country in the world. Our own experience compels us to maintain that it is by long odds the best telephoned now without them; while there is every sign of a more rapid rate of growth here than ever before. In the meantime, it is interesting to note that the volume expresses admirably Mr. Richard Croker's sentiments in favor of a municipal gas plant. That distinguished reformer and economist knows what is most advantageous for a community.

The book is a valuable addition to municipal literature and, like the important series to which it belongs, should be carefully studied.

AMERICAN ELECTRICAL CASES. A collection of all the important cases (excepting patent cases) in the state and Federal courts from 1873 to 1897, on subjects relating to the telegraph, the telephone, electric light and power, electric railway, and all other practical uses of electricity, with annotations. Edited by William W. Morrill. Albany, N. Y.: Mathew Bender. 6 vols. Price, per volume, $6.00.

The growth and development of the law is most emphatically shown by the increase in the number of cases. The editor finds that he can, within the limits of the first volume, cover a period of thirteen years, with 155 complete reports, and in memoranda, of some 30 additional cases; while in the second volume he is able to cover a period of only three years, although he reports as many cases. Each of the other volumes covers approximately two years.

The volumes are arranged chronologically, while the cases in each volume are arranged under a series of subjects, differing slightly in the different volumes. Taking a volume at random, we notice cases upon the following subjects: The municipal control of street uses by electrical companies; the compulsory placing of wires underground; the right of abutting land owners in respect to the use of highways for electrical purposes; the maintenance of telegraph lines upon railroad rights of way; the crossing of steam railroads by electric railways; the interference of one user with another; the negligence of electrical companies in the maintenance or operation of their apparatus; the status of electrical apparatus as property; the proposition that the production of electric light is manufacture; the discrimination by telephone companies; state regulation of telegraphic rates; state and municipal taxation of telegraph companies; the obstruction of navigable streams by electrical cables; the power of municipal corporations to engage in the business of electric lighting; the conversion of the wires of one electrical company by servants of another, and the duties of telegraph companies to their patrons and the public.

THE ARITHMETIC OF CHEMISTRY. Being a Simple Treatment of the Subject of Chemical Calculation. By John Waddell, B. Sc., London; Ph. D., Heidelberg; D. Sc., Edinburgh; formerly Assistant to the Professor of Chemistry in Edinburgh University. New York: The Macmillan Co. 137 pages. Price, 90 cents.

This little book is designed for the use of students in chemistry, and for teachers in explaining various knotty points in that science. There is evidence also of its having been prepared as an aid to the student in answering the questions which are likely to be set in college examinations. It has seven chapters, entitled: Calculation Weights of Elements; Simple Calculations of Weights; More Complex Calculations of Weights; The Volume of Gases; Calculations Involving Weight and Volume; Calculations in Volumetric Analysis; Calculation of Formulæ. After these follow seven appendices, namely, The French System of Measures; Arithmetical Calculations; Comparison of Thermometric Scales; Tables of Calculation of Atomic Weights; Equations in Frequent Use; Pressure of Aqueous Vapor; Table of Logarithms. There is no index.

The author has evidently a thorough grasp of his subject and exposes it in simple arithmetic. Numerous examples are worked out and many others are added at the ends of the chapters. Great care is taken to make clear that difficulty which so many elementary students encounter in regard to the volume occupied by different gases under standard pressure and temperature, and all the chemical calcalculations are expressed in such form as only to yield readily interpretable voluminal results. Thus, the equation representing the decomposition of mercury oxide into mercury and oxygen, instead of being written in the time-honored fashion

$$HgO = Hg + O,$$

which leaves a single atom of oxygen in evidence, is written

$$2\,HgO = 2\,HgO_2,$$

which leaves a molecule of oxygen and one occupying the standard molecular volume. Another novelty is the use of italicised letters, as in the above equation, to represent a gas.

Altogether the book contains much that will be welcome not only to the elementary but also to the fairly advanced chemical student. The language sacrifices ornament to simplicity, and the print is excellent. The metric system is used throughout.

Wireless Telegraphy in Paris.

M. Ducretet has recently made some successful experiments in wireless telegraphy between stations in Paris. Signals were successfully sent from the Pantheon to Montmartre, and also from the latter place to Eglise Ste. Anne, a distance of 4½ miles. Recently M. Ducretet has established a service between Villejuif and his laboratory, a distance of 7½ miles. In all the experiments thus far the signals have been transmitted without interruption, even during rains. In some cases they were read at the receiving end by means of a sounder, and in other cases recorded on a modified Morse register, which has an automatic attachment whereby a signal received at any time is recorded without the presence of any attendant. As an instance of the facility with which stations may be established, that at Villejuif was put up complete in half a day.

An Electric Gun for British Navy.

The Daily Mail, of London, of May 13, says that the admiralty has offered £75,000 ($375,000) for an electric gun invented by the son of a Portland grocer. The gun throws an explosive shot a distance of five and a half miles in two seconds. It is noiseless and smokeless.

Gold Car Heaters.

The Gold Street Car Heating Company of New York and Chicago, makes an exhibit of a complete line of the improved type of Gold electric heaters. This type of heater is the one in which the zigzag rod or support is used for the resistance coil. Very extensive tests recently made show that the efficiency of this heater in the matter of delivering warmed air into places to be heated, was nearly 30 per cent. greater than that of any other electric heater in competition. A longitudinal car seat is also shown fitted with the latest design of the Gold three-degree panel electric heater. This heater is divided into three even sections and when placed in a car all are controlled by a three-point regulating switch, so that one-third, two-thirds or the full capacity of every heater may be had at any time, according to the outside temperature. The very even method of graduation insures a uniform and comfortable distribution of heat at all times.

A Hale & Kilburn walk-over seat is shown fitted with a Gold standard heater, and its appearance indicates that its construction and the manner of connecting with the regulating switch are extremely simple. Over twenty other designs of electric heaters using the Gold resistance coil and support are shown, all suited to different purposes, some of them being designed for steamships and others for house-warming. A large heater, capable of delivering 300 cubic feet of air per minute, heated to a temperature of 250 degrees, is also exhibited. This heater is fitted with a Sturtevant blower operated by a Lundell motor. The amount of heat developed and the very rapid circulation of air through the coil enables it to warm a very large apartment. The popular feature of the Gold exhibit, however, is the electrical fire-place, placed at one corner of the booth. This was designed by Mr. Edward E. Gold, president of the company, who is also the inventor of all of the electrical and car-heating apparatus manufactured by that company. This fire-place is a very attractive affair. It is faced with a green tile about 2½ inches square and finished with a heavy ornamental brass work; a large mantle over-hangs the hearth. The fire-box encloses the resistance coils and the latter when heated give off a large volume of heat. To give a more natural appearance, a red glow is thrown down on the logs by means of colored electric lights concealed above the fire-place. This feature of the exhibit has attracted a great deal of attention and excited favorable comment among all who are interested in the development of electric heating.

The exhibit is looked after by Mr. H. S. Kemp, assisted by Miss Beatrice Goldsmith. Mr. John E. Ward, manager of the company, is also in regular attendance at the exhibition.

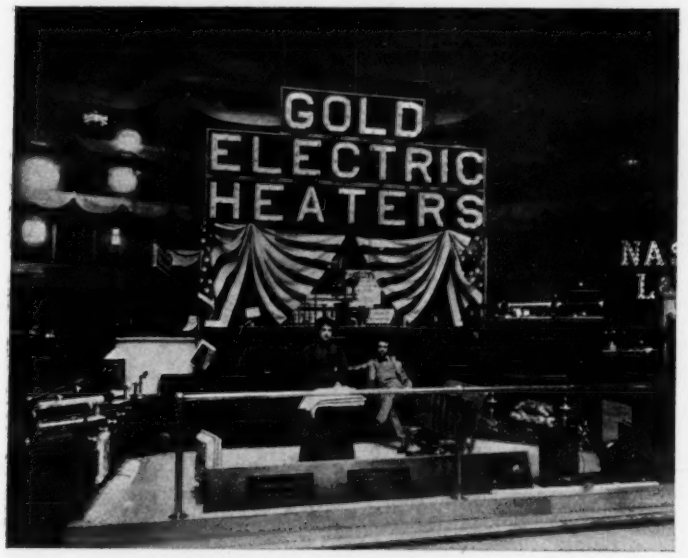
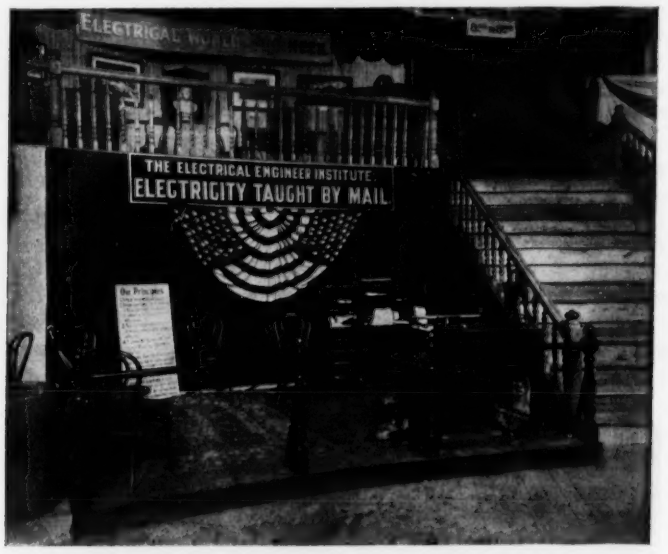


EXHIBIT OF GOLD ELECTRIC HEATERS.

The Electrical Engineer Institute of Correspondence Instruction.

From the exhibition standpoint, the above-named concern may be said to have made its debut at the Garden last year, when its booth near the Madison Avenue entrance, was one of the leading centres of attraction. The work done within a single year by it, under the management of its president, Mr. Joseph Wetzler, has been phenomenally successful, and it is able to meet the public again with valid claims for support, offering performance and testimonial in the place of promise. During the year Mr. Wetzler has rallied to his service some of the foremost electrical engineers in the country as authors of the institute instruction papers, and the endorsement of the Institute and its methods has been universal throughout the profession.



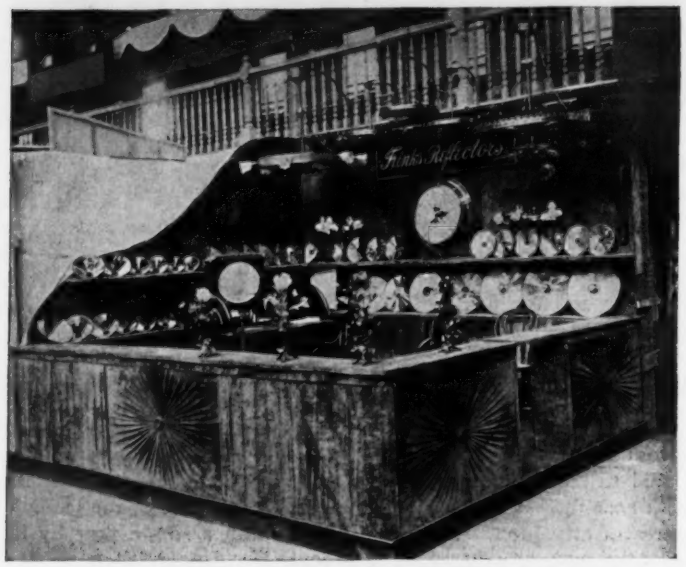
BOOTH OF THE ELECTRICAL ENGINEER INSTITUTE.

At the Garden this year, the booth of the Institute has been made of special interest, as usual, by a live exhibit, the chief feature of which is a liquid forge in full operation. Once the spectator's attention is engaged by this, he finds himself unconsciously taking in a popular lecture on electricity, and before he knows "where he is at" he has become a student in embryo ready for his first instruction paper. If there were more exhibits like this in the Garden, it would be hard to over-estimate the educational value of the Show as a whole.

Besides distributing its regular literature freely, the Institute gives away a neat little brochure of electrical information, so meaty and useful, it might well be called an electrical pocketbook in miniature. The public is evidently keen after data on electrical matters. It yearns after the ability to size up volts and amperes, and desires to substitute sound knowledge for the irresponsible yawpings of the sensational press. It other words, it craves to be taught.

Frink Reflectors.

Frink's reflectors are displayed in a booth which is looked after by Mr. Frank Stout. There is exhibited a full line of reflectors, including the Frink window reflector, which is so extensively used in store windows, cluster reflectors and a general line of flat and cone shades. A special feature of the exhibit is the ceiling light at the back of the booth. This light has a brass corona handsomely



FRINK REFLECTORS.

finished in polished brass and is particularly suited for banks, office and public buildings, stores and general use. It has a cluster of five lamps, at the center of which is a stalactite. Along the back of the booth are electric fixtures, the lamps of which are shaded by silk flowers, which gives a very pretty effect at night time. Another notable article on exhibition is a 35-inch cluster which is used for large halls, churches, theatres, etc. It is trimmed with a row of cut-glass prisms and is finished with brass crown bands having lights on the outside of the circumference. There are also shown some jardinieres electriques which form a very attractive novelty.

The Scranton International Correspondence Schools Exhibit.

Among the interesting and novel features of the show is the booth of the International Correspondence Schools of Scranton, Pa. The arrangement of the front has attracted much attention from its tasteful design in which the pillars are close imitations of the bound volumes of their instruction and question papers supporting a profile sign, which shows the College at Scranton, Pa., and the New

INTERNATIONAL CORRESPONDENCE SCHOOLS' EXHIBIT.

York office. Correspondence instruction has come so prominently before the public, especially in later years, that everyone feels a personal interest in investigating the claims of the schools and understanding the system of teaching. These schools were founded in 1891 by Mr. T. J. Foster, who has developed the institution from a mining course, which was demanded of him by the workmen in the mining district of Pennsylvania in order to qualify for state examinations, which the Legislature required at that time. Some idea of this popular method of instruction can be obtained from the fact that there are now enrolled in these schools 90,000 students who are studying in a variety of subjects, of which there are fifty complete courses shown by this company. A very interesting part of this company's exhibit is the work of the students, which is corrected by an instructor from the college in Scranton, who also explains the miniature apparatus illustrating electric transmission by three-phase alternating currents taken from a rotary converter. This machine was made by one of the students from materials furnished by the schools. The souvenir hand-book, which is freely distributed, gives a very complete idea of the work of the schools, and also contains some very interesting electrical data.

The Crocker-Wheeler Company's Exhibit.

The Crocker-Wheeler dignified and interesting display, illustrated by the accompanying cut, is attracting large numbers of the exposition visitors within its railing. The public is surprised at the magnificent proportions of a field ring twelve feet in diameter and is somewhat incredulous that such attention as indicated in its graceful outlines should be given to the design of apparatus for the generation of electric current. The generator of which the exhibited field ring is a part is one of several 400-kw machines which have been ordered by the Smelting Corporation, Limited, of London, England, through the Crocker-Wheeler agents, the General

CROCKER-WHEELER APPARATUS.

Electric Company, Limited, of London, England. Only the field ring could be exhibited, and it stands in the midst of an array of what a few years ago, would have been called large motors, but which suffer sadly by comparison with respect to size, as they are exhibited around its fourteen tons of metal. The company's improved form of brush rigging giving individual adjustment of the brushes and having holders of the parallel movement type, is held in place by massive brackets. It is the largest single piece of electrical apparatus at the show, this company having the distinction of exhibiting last year the largest electric generator.

There is a complete line of bi-polar machines, sizes ⅛-hp to 7½-hp, a sprinkling of their multipolar type machines 10-hp to 225-hp in belted machines, some slow speed motors, and parts of larger size direct connected units, sufficient to enable the visitor, be his inspection ever so casual, to form some idea of the range of standard machines which this company makes in order to compete with the present demand for a great variety of motors and generators for power and lighting purposes. During the past year this concern has pushed ahead in the matter of design for machines of large units, and now builds direct connected machines up to 750-kw. This one shown is their size 672. Other machines of direct connected type manufactured by them are: Sizes 448, 280, 224, 170,

112, 84, 56, 33, and 23, the last mentioned size giving 20-kw at 300 r. p. m. Their slow speed motors for printing press work are made in standard sizes from ½-hp to 5-hp, at 100 r. p. m.

A particularly interesting line is their "Mill" or inclosed type, which is exhibited in size 6 of 6-hp. They also make sizes 14 and 22 in this line specially designed for "toughness," great starting torque, ready reversal, and protective form.

The company's special type of brake motors is illustrated by size 7½ of 7½-hp, which is its bi-polar line of machines with the brake element added. The brake action is obtained by means of a pivoted field and strap. They are made both "one-way" and reversing, and are used for cranes and hoists where an accurate and sure stopping is required.

Similar to its line of mill motors is its elevator type which combines the features of toughness and adaptation for constant reversal of its mill motors. Controlling devices and rheostats manufactured by the company are exhibited in a variety of sizes. One cannot fail to be impressed with its solidity, and the success which has been attained by the company in its desire to supply machines of first-class workmanship for a variety of purposes.

The exhibit is in charge of Messrs. Blackall and Baldwin, assisted by their entire staff, Messrs. Black, Ketcham, Crawford, Smith and Adams. Some of the officers of the company, notably Mr. A. L. Doremus, secretary, and the members of the Engineering and Sales Department are frequently in attendance and take pleasure in explaining the exhibit to inquiring strangers.

Exhibit of the Stanley Electric Manufacturing Company.

A very interesting and complete exhibit of their instruments is made by the Stanley Electric Manufacturing Company, of Pittsfield, Mass., including their static voltmeters, static ground detectors, alternating and direct current hot wire ammeters and voltmeters, portable ammeters and voltmeters for both kinds of current, high potential switches, lightning arresters, live cut-outs and fuse blocks, circuit breakers for alternating current and transformers. The latest types of these standard and well-known instruments are well displayed in a booth on the main aisle under charge of Mr. Barr, whose time is fully taken up by visiting electrical engineers.

A special feature of the exhibit consists in the new portable and station voltmeters. These instruments are compensated for all variations in temperature, are dead-beat and extremely accurate, being guaranteed to be within one-half of 1 per cent. in the portable type

STANLEY ELECTRICAL INSTRUMENTS.

and within 1 per cent. in the station type. In addition to this they are capable of universal use, being adapted for service on direct or alternating currents of any frequency or wave form. In the portable type this is of great importance, as most engineers will testify. Oftentimes in preparing for a test, an engineer will find that the instruments are not adapted to the circuit which is to be measured. Another good feature of these instruments is their flexibility. This is well demonstrated in the Stanley exhibit. They have there for example, a milli-voltmeter adjusted to a variety of shunts, such that the one instrument will give a maximum reading of 5, 50 or 500 amperes. Equipped with such an instrument, one can go forth confident that no matter what eccentricity of machinery or current or conditions turns up on the circuit, the engineer is able to make his measurements with thoroughness and accuracy.

The instruments shown are well designed and present a very attractive appearance, being finished in black japan and brass. The ammeters being designed for use on the high potential side are most carefully and highly insulated, and are mounted in a hard rubber case with a glass front. They will easily stand 10,000 volts between case and movement.

Columbia Automobile Exhibit.

Central station men, who attend the convention of the National Electric Light Association, will be much impressed by the exhibit of the Columbia Automobile Company at the Electrical Show.

COLUMBIA AUTOMOBILES.

Their exhibit includes a brougham, emergency wagon for street railway service, delivery wagon, hurry-up wagon for electric light companies, stanhope, dos-a-dos trap, ladies' Victoria and Victoria "Dauma."

The emergency wagon is one of the two built for the Consolidated Traction Company, of Pittsburgh. It is equipped with two Babcock fire extinguishers, extension ladder, stretcher which is hung with springs on hooks in case it is necessary to use the vehicle as an ambulance, with full equipment of tools ordinarily in use in a wrecking wagon. It has attracted a great deal of attention from street railway men who have seen it, and is favorably commented upon.

The Columbia brougham is finished in dark green and black, and is very elegant in appearance. The interior is upholstered in dark green goat skin, equipped with an incandescent lamp, push-button for signalling driver, corner head-rest; and the roof is done in handsome dark green satin. The vehicle is striking in appearance. Awkward lines and heavy appearance which have generally been seen in this type of automobile, have been eliminated. The wheels are decidedly light and attractive.

The "Ladies' Victoria" is a gem. It is upholstered in light café broadcloth with automobile red body and running gear. Although fast running, making 15 miles an hour on the level, it is very easily handled and controlled by a lady. The run-about or hurry-up wagon for central station men will make the mouth water of many a visiting member of the National Electric Light Association. It is very speedy, stocky and strong, but exceedingly attractive in appearance. The dos-a-dos golf trap attracts much attention with its hamper between the seats and the golf basket hanging by the side. The stanhope is the latest pattern of this type of vehicle, and has a rumble on the back for footman which is removable. A full detailed description of the Columbia automobiles appeared in the ELECTRICAL WORLD AND ENGINEER of May 6. The exhibit includes also a switchboard and one of the New York Edison Company's "hydrants" designed for "nickel-in-the-slot" street charging of automobiles.

The Group of Government Exhibits.

Under the energetic supervision of Mr. Ira W. Henry, who has given no end of time and trouble to it, a beautiful and most interesting loan exhibit from the United States Government has been put together, occupying almost the entire north side of the Garden promenade, over-looking the main floor. A good general view of

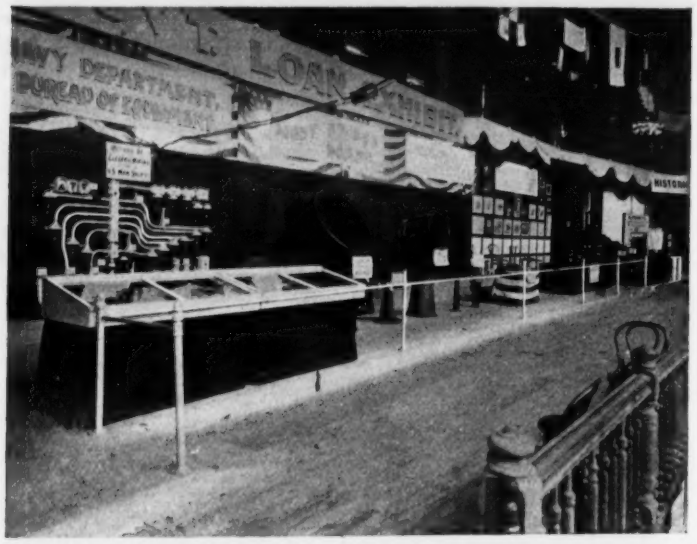


EXHIBIT OF NAVY DEPARTMENT.

it appeared in our issue of last week, and we present this week some pictures of it in greater detail. The eye is attracted first by the generous display of bunting and Signal Corps flags, and there is one long string of signals which, we are told, reads "Manila Is Ours"—a fact which not even Aguinaldo will deny, and which comes home with peculiar force to those who were at the opening exercises of the exhibition in 1898 and who recall the anxiety and enthusiasm of that evening when we were all waiting for news from Dewey and his little fleet.

The services contributing to this government collection are the War and Navy Departments, the United States Lighthouse Board, the United States Department of Agriculture, the Smithsonian Institution and the United States Signal Corps. Most of the smaller exhibits are grouped in cases under glass, each with its appropriate label, while the larger ones range along, within the rail, and a backboard is devoted to pictures, charts, etc. To enumerate in detail all the interesting objects would be impossible and we present merely a summary.

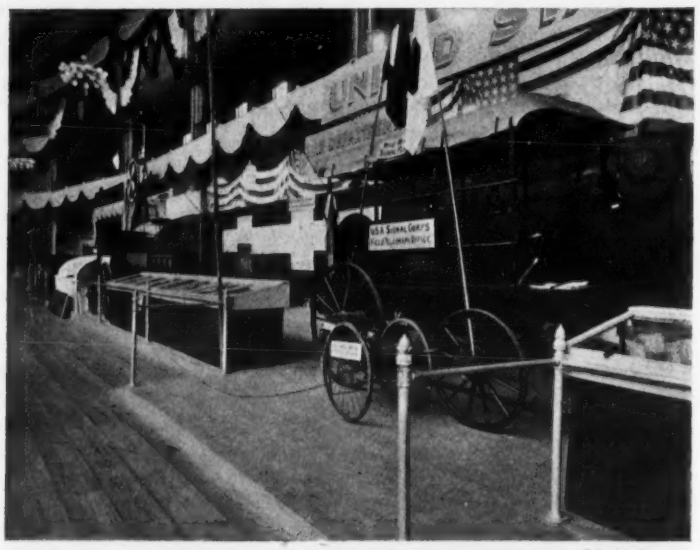


EXHIBIT OF U. S. SIGNAL CORPS.

The most conspicuous of the government exhibits is that of the United States Signal Corps, through the courtesy of General A. W. Greely, and it comprises the following: A flying telegraph cart, which contains different types of light telegraph wires and cables, as used with the advance guard of the army to keep the commanding general in constant communication with the front. A telegraph wagon and truck, used for carrying a "central office on wheels" and the light steel telegraph poles used for rapid construction. Hand reels, containing aluminum bronze wire, used for sentry purposes, the soldier paying out the wire as he advances and keeping in constant telephonic communication with the guard house. An outpost cart, showing the old type of wire for telephonic communication with outposts. A switchboard used at Ponce, Porto Rico. It was constructed by Lieutenant-Colonel Reber out of sugar kettles, captured from an enemy's plantation. Telegraph kit used at Santiago, over which was flashed the message of the surrender, and before that was constantly used in our intrenchments, keeping the White House informed of all the happenings at the front. Map of battle line at Santiago, showing by diagram how the signal officers connected the different intrenchments by telephone with headquarters. Heliograph—Various instruments used by the Signal Corps for sending messages by wig-wag, telegraph, telephone and night flash-light method; signal flags and practice kites, international code flags, acetylene gas lamps, oil lamp and screen, mainline sounder, Graham-Meyer torch and type C. and D. instruments. These instruments were designed by Colonel James Allen, and are peculiar, owing to the fact that an alternating or buzz current is used in the transmission of messages, thus allowing one, by the use of a transformer, to raise the voltage to such an extent that a message can be sent over a great distance without the aid or relays.

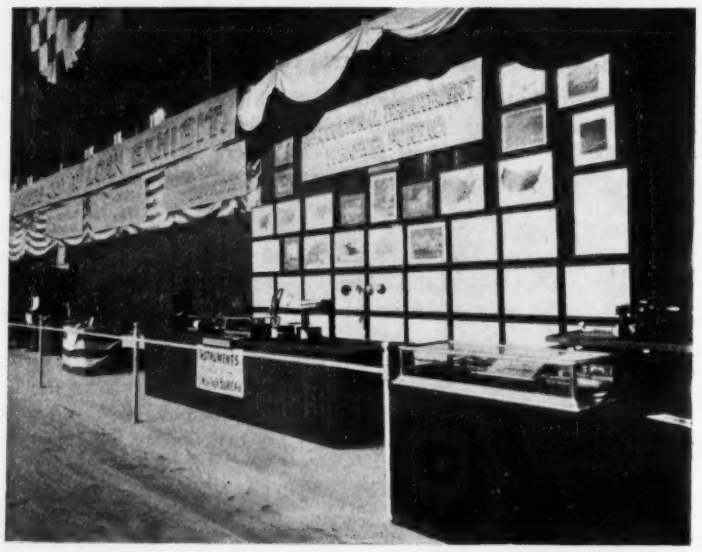


EXHIBIT OF WEATHER BUREAU.

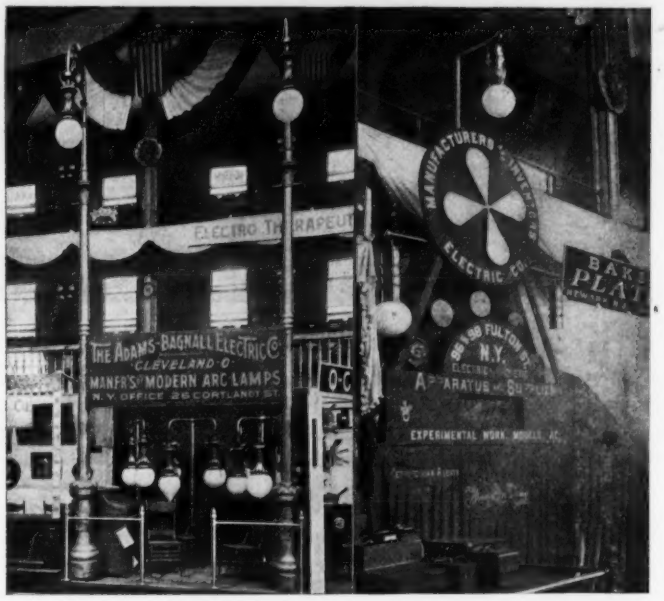
Next in importance comes the exhibit from the Navy Department, through the courtesy of Rear Admiral R. B. Bradford: Night signal system; using the different combinations of colored lights, the vessels of the squadrons are enabled to communicate at night. Battle-order indicator, showing method of communication between commanding officer and the gun crews. Helm-angle indicator, showing at all times the exact angle of the helm, thus allowing the instantaneous training of guns to the right elevation. Diving lamp, designed for deep sea diving, carried on all vessels of the navy. Conduit sample board, showing the method of waterproof conduits for carrying all electric wires used on shipboard. Samples of various electrical material used by all vessels of the navy. Method of Wiring, showing special cut-outs, branches and switches, known as "Navy standard." Vizcaya projector—This searchlight was captured at the battle of Santiago from the Spanish cruiser Vizcaya, and was put in active operation on the U. S. S. Texas to replace the one destroyed during the battle. This searchlight was used by the Spaniards during the blockade of Santiago to illuminate the entrance to the harbor ,and at the time of Hobson's adventure disclosed the presence of the Merrimac to the shore batteries. Searchlight recovered from the unfortunate United States battleship "Maine."

Thanks to the kindness of Captain S. M. Ackley, U. S. N., Naval Secretary, the United States Lighthouse Board illustrates the electric buoy system in both the low-tension type and Mr. I. W. Henry's alternating current system, upon which present methods of operation are based for such work as that in Gedney

Channel. The Smithsonian Institution contributes material bearing upon the early work of Professor Joseph Henry and the United States Weather Bureau, through Mr. E. Hutchinson Emery, local weather forecast official, sends a variety of the apparatus used to obtain records which are shown. It is accompanied by about 200 square feet of photographs and charts illustrating climatic conditions, weather telegraphic circuits, cloud forms, lightning, etc. The exhibit includes a triple register, with sample records, a barograph and a thermograph, both complete; an emometer, with cups, and iron stand for mounting; small model wind vane, with electrical contacts, mounted; electrical sunshine recorder; weighing rain and snow gauge, and 48 miscellaneous framed charts and photographs.

The Manufacturers' and Inventors' Electric Company.

The revolving fan trade mark of the Manufacturers' & Inventors' Electric Company, of New York, attracts attention to the booth from almost every part of the garden. Under it is a large disk, revolving in a vertical plane, on a periphery of which are a series of small bright-colored disks, also turning on their axes. The com-



A COUPLE OF EXHIBITS.

binations of the motions and colors readily attract the eye from a great distance. The commercial features of the exhibit include five Morris enclosed arc lamps, three hanging at the back of the booth and in operation, and two suspended within the enclosure, their casing being removed to permit examination of the interior mechanism. One of the latter lamps is made to burn across 220 volts. It gives a very steady light and is said to be proportionately more economical in its operation than the 110-volt lamps. The Manufacturers' and Inventors' Electric Co. is the metropolitan agent for the Morris lamp, which is designed for use on constant potential circuits. It is extremely simple in its construction. The carbon-feeding device consists of a single solenoid or magnet, the core of which directly engages the carbon rod by means of a washer clutch. The sudden movement of the carbon is checked by means of a self-lubricating dashpot provided with a graphite plunger. These comprise all the parts of the feeding mechanism, clockwork, escapements, racks, etc., being entirely eliminated in this lamp. The Morris lamp is made for use on 110, 220 and 550-volt constant potential circuits. Among other apparatus and devices which will be exhibited by the Manufacturers' & Inventors' Company during the month may be mentioned the telegraphers' "Morse Watch"—a very compact Morse sounder and transmitting key; the "Mandiphone" and Morsegrams, the Lennox automatic glove contest timer, electric horse clippers and cleaners, Troy electrical test instruments, and telegraph and telephone military campaign outfits. The phonograph records of the Morse transmissions of the telegraph tournament, held during last year's electrical exhibition, will also be placed on exhibition. Mr. A. H. Smith, son of Manager T. J. Smith, frequently visits the booth in the evening, as does Mr. W. L. Cordo, the secretary of the company. Mr. F. Miller also looks after the company's interests.

Adams-Bagnall Arc Lamps.

The ordinary arc lamp man tries to show how large a space he can cover with one arc lamp. At the Electrical Exhibition, Mr. C. W. Phipps, who needs no pointers in that particular direction, has played an original variety on the theme, and to show the compactness of the arc lamp makes and mechanisms of the Adams-Bagnall Electric Co., of Cleveland, has crowded more arc lamps to the square foot than mortal eye ever saw before. His exhibit on the southern aisle is well worth study by every electric lighting manager and by all engaged in the electrical trade. It comprises a full line of modern arc lamps of the latest design and finish, in practical working order, illustrating all types and kinds of current supply. At the entrance are two tall and stately iron arc light poles, made by Mr. Harry E. Campbell, of Albany. These are surmounted by two of the well known series enclosed arcs of the "A. B." type for street work.

As specialists in the various lines, the Company, for whom Mr. Phipps is Eastern agent, exhibit within the booth their series enclosed direct current arc lamps; series open arcs; alternating enclosed arcs; constant potential direct current enclosed arcs for 110 volts; constant potential series enclosed two across 220 volt circuits and five across 550 volts; constant potential one in multiple on 220 volts. In addition to these there is a very short ornamental safety series lamp of the open arc type for special commercial work indoors, for low ceilings, etc. It burns from 13 to 14 hours. The exhibit contains also a pointed globe series open arc lamp, taking a full length carbon that will operate inside for from 19 to 20 hours and from 17 to 18 hours outside. The entire exhibit is in its way the best collection of modern arc lamps that the public has seen in a long, long time.

Historical Exhibit of Old Arc Lamps.

In sharp contrast to the beautiful displays found elsewhere in the Garden, in the commercial exhibits of modern arc lamps, bright in all their glory of fine finish and accurate mechanism, is the striking collection of old arc lamps got together with infinite pains and trouble for the occasion by Messrs. E. F. Peck, C. W. Rice and G. H. Guy. It is placed just beyond the government exhibit. To the ordinary public it lacks seriously the interest of that collection so full of electrical relics of the war with Spain, but to the old

HISTORICAL LAMP EXHIBIT.

electric lighting man these bare, grim rows of rusty lamp frames are far more vocal as to fierce struggle, the expenditure of vast sums of money, of failure and triumph, and of the final victory of the best forms surviving because of inherent merit. It will be a pity if this collection cannot be kept together and placed in some college or museum as a record of the early stages in the development of a great art in the closing years of the nineteenth century.

The collection is grouped under upright glass cases and on long racks such as are found in the testing room of an arc factory or

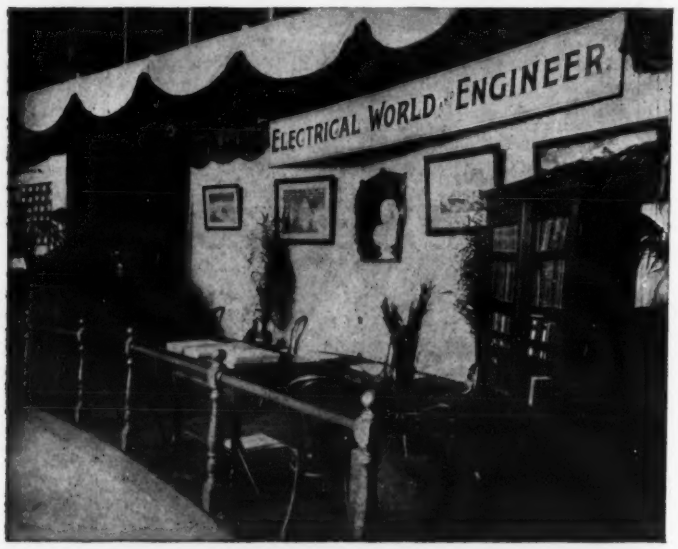
central station. It includes a fine "old-timer" in the shape of a handfeed lamp made by Professor R. Ogden Doremus and exhibited by him at the Academy of Music in Brooklyn in 1854. What a history intervenes between it and the latest 150 hour enclosed arc down on the main floor! There is also shown a multiple arc lamp from Prof. Doremus, of the same year; and the same contributor has also loaned a Dubosq lamp which he imported in 1855. Then comes a gap and the next great step is shown in the Jablochkoff candle arc of 1872. Another gem is one of the first four series arc lamps manufactured in the United States and tested at the Wallace factory, at Ansonia, Conn., in 1875, in the presence of William Wallace, Prof. W. Draper, T. A. Edison, Prof. W. H. Barker, C. F. Brush and Prof. C. F. Chandler. This treasure has been loaned by Dr. L. H. Laudy, of Columbia University. Next is shown the first lamp built by Mr. Brush, and loaned by Mr. S. M. Hamill, Jr., while Mr. Thomas E. Murray has sent a No. 2 Brush lamp made about 1877. It has been in continuous operation since then until now on the circuits of the Albany Electric Illuminating Company, and was only taken down for inclusion in this exhibit. Its sturdiness reminds one of the old saying, that the only testing it needed was to drop it from the top of the station to the sidewalk, when it just shook itself and felt better. A No. 3 Brush lamp, built in 1879, is also shown, loaned by Mr. Hamill.

We come again to another memorable period in the original Thomson lamp, made about 1879 by the earliest Thomson-Houston Company, and used with Prof. Elihu Thomson's first three-coil machine, the first provided with shunting mechanism and regulator on the machine. Another Thomson lamp, made in Philadelphia in 1879 illustrates what was called the "drop-and-lift" principle.

With Edward Weston's lamp, made about 1880, we reach the more modern and recent period, and then follow, each illustrating some form or mechanism, many having disappeared from the art while others remain, the lamps of Schefbauer, Lemaire, Piefer, Kinsman, Arnoux-Hochhausen, Knight, Ward, Helios, Sterling, Eschweis, Adams-Bagnall Electric Arc Lamp Co., Western Electric, General Incandescent Arc Light Co., Haines, and the General Electric Co., rounding out the full term of fifty years and more. Supplementary to these again are a few of the incandescent lamps such as the Bernstein, with its paper fusing arrangement, intended to operate on the series circuits with which modern arc lighting began.

"The Electrical World and Engineer."

The consolidated journal bearing the above name occupies a space this year in Newspaper Row, on the promenade, equal to that occupied by THE ELECTRICAL ENGINEER and ELECTRICAL WORLD



BOOTH OF "THE ELECTRICAL WORLD AND ENGINEER."

last year, its booth being located alongside the stairway leading from the main floor into the concert hall where the various meetings and exercises are held. The space, 20 feet by 10, is upholstered in dark and light green and fenced in by olive green railing. The back wall is hung with a series of engravings and photographs, one showing the illumination of the Omaha Court of Honor by incandescent lamps; one, the Chicago Court of Honor and the Electric Fountains by night; one the Great Eastern on her 1856 cable expedition, and one the Jungfrau Mountain and the beginning of its electric road. Another picture shown within the space is the only copy in this country of Bertini's historical painting of Volta and Napoleon discussing the first battery. Centrally placed in the wall of the exhibit is a draped niche containing a large bust of Franklin. At one end of the exhibit are desks for the working force, and at the other a bookcase containing the latest standard electrical literature. At the front is a table from which hundreds of copies of the paper are freely distributed daily. At the rear along the base of the wall runs a low divan, sitting upon which the visitor obtains one

EXHIBIT OF THE DALE COMPANY.

of the best general views of the whole show. On one of the desks is shown a model of the hull of the latest Holland submarine boat, loaned by Mr. Robert McA. Lloyd; and from time to time various other objects of interest are included in the exhibit.

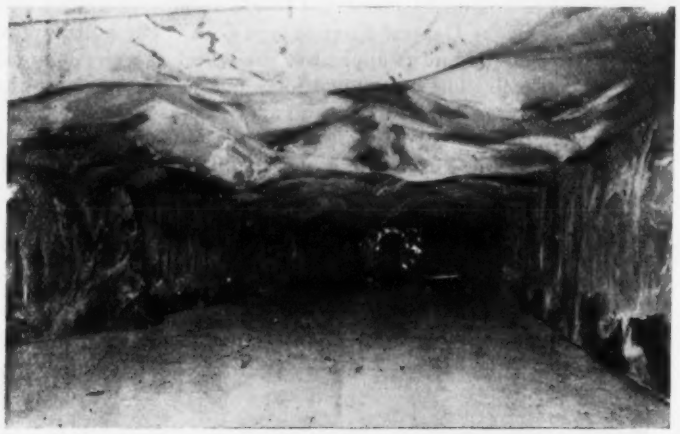
The Dale Company.

The Dale Company makes an exhibit of a general line of fixtures and specialties, the most important feature being an arc lamp designed to burn on either alternating or direct-current. This lamp is of the open arc type and is known as Dale's Pendant Arc. It possess among other advantages the particular feature of economy, burning 100 hours on an average of 4½ amperes and giving a brilliant and steady light of 1200-cp. It strikes the arc without pumping and burns at any angle, thus making it especially suitable for marine work. The lamp is claimed to be the simplest on the market, and has fewer parts than any. It weighs but 12½ pounds and is 28 inches long. The lamp is packed for shipment and delivery in a neat wooden box, which also includes the globe. The box is labeled, showing the voltage and current of the lamp, and it can be placed on a shelf and kept in stock in supply houses. The exterior dimensions of the box are 29 inches long by 10 inches square.

The furnishings of the booth in their general appearance are very attractive. They are built of brass finished in rich gilt, the booth constituting a huge fixture in itself, being wired throughout and lit up. The company is also displaying a complete line of desk portables, electric, and combination chandeliers and brackets. The porcelain multiple receptacle is one of the new additions to the regular line of specialties. It requires no sockets, wiring, shade holder, or insulating joint and cannot be short circuited. Many of the large street railway companies are using these fixtures for lighting their cars. An electrolier of special design and with six lights is suspended at the centre of the booth. It is finished in rich gilt and has straw opalescent balls. Over the entrance to the booth is the word "Dale" in plain block letters which are illuminated by incandescent lights at night. Three arches of brass tube span the front of the booth, the artistic design of which may be seen by reference to the accompanying illustration. The booth was designed by Mr. J. H. Dale, president of the company, and all the fixtures and fittings were placed and wired by his own men. The Dale Company keeps a uniformed delivery boy at the booth for the immediate delivery of goods, running errands, etc.

Current Notes of the Exhibition.

The electrical exhibition at Madison Square Garden has now entered upon its third week, which, owing to the presence of the National Electric Light Association is likely also to be one of the busiest. The attendance has been gaining rapidly, attesting the general appreciation of the merits of the show by the public. While the electrician and electrical engineer sees little that is new from year to year, affording justification for such an exhibit, the public somehow realizes that it has much to learn about electricity and it has no objection to any titillation of its love of marvel and mystery. That such a show can be held in a city like New York and be attended by thousands of people nightly, without doing practical good, is impossible. The reports from exhibitors as to inquiries and sales are most encouraging and convincing. General Manager Nathan, to whose hard and intelligent work to much of the success is due, says that the most impressive feature is the high quality of the people who come. They represent every station in life, but society people are very numerous and always in evidence. The electrical exhibition is said to be excelled only by the Horse Show in bringing out a strong "swallow-tailed" contingent.



IN THE GROTTO.

During the past week, a very handsome Riker dog cart automobile has been placed on view by itself, and is offered by the management to the actress receiving the greatest number of ballots. Up to the present moment, Miss Maude Adams, now playing Juliet, has been in the lead, but Mrs. Leslie Carter, who is playing Zaza, is a pretty close second. Some thirty or forty actresses are already in the lists, and the public is taking the keenest interest in this novel contest.

One of the most interesting parts of the present exhibition is the "Grotto" as it is called. It consists of the basement and annexes, and constitutes what may very properly be called the "Midway." Between the two sides of the basement and right under the principal cross aisle on the main floor is the "tunnel," where the elephants are stalled when Barnum's circus is in town. Usually it is a dark and dismal place, but the genius of Messrs. Nathan and Stieringer has converted it into one of the most attractive portions of the show. The scenic artist Chambers has lined the walls and roof of the tunnel with painted canvas simulating rocks and caverns, and the stalactitic roof is studded with colored incandescent lamps. At one end this grotto is flanked, on the south by the diving tank in which Capt. Sorchio and his wife give admirable demonstrations of the uses of electricity under water in regular diver's costume. Mr. W. J. Clark has an excellent Roentgen ray booth there and Mr. Caldwell also displays the effects obtainable with his ingenious form of Wehnelt interrupter. In the middle of the tunnel is an artificial cave, which is nothing more nor less than an ingenious form of d'Arsonval cage devised by Dr. Cyrus Edson and placed longitudinally instead of vertically so that people can pass through. The cave is energized by a fine Waite & Bartlett static machine motor driven, and as the crowd passes through the discharge from the sides creates the curious illusion of a wind blowing upon them, while there are tablets in the side upon which they are invited to make the attempt to write. At the north end of the tunnel, Mr. J. Carl Mayrhofer, the well-known inventor of electrical stage effects, has set up mimic theatre in which he shows how the electric lighting is done in some thirty scenes from well known plays. There is in addition, a working model of a theatrical "gas bank," which shows how all the changes of color and gradations of light are obtained. In the centre of the theatre hangs a theatrophone connected through the system of the New York Telephone Company so that either the music of the distant Estey organ on the main floor can be heard or the music of comic operas from various theatres in the city. A group of several score of people can thus listen at a time.

Music at the Garden.

All through each day and evening, visitors at the Garden are entertained by music from a large pipe organ placed immediately over the main entrance to the ampitheatre. The organ is furnished by the Estey Organ Company and the pumping is done by a Lundell motor, connected with the bellows through worm gearing and pulleys. Above the organ is an electric light sign bearing the name "Estey Organ Company." This sign shows very prominently at night from every point in the Garden.

Machado & Roller.

Along the southern promenade, just beyond Newspaper Row, is to be found the neat exhibit of Machado & Roller, of New York City, who have lately concluded with the Whitney Electric Instrument Company an arrangement whereby they become the general selling office of the manufactures of this concern. Their exhibit covers many interesting developments in the instrument line. The glass case switchboard machines for high tension alternating current would be extremely well adapted for high tension work. The transformer type of alternating current ammeter also exhibited whereby the heaviest current may be taken care of without difficulty and the instruments placed at any desired distance from the main buses without additional cost, is also of interest. Machado & Roller report that the dead beat qualities of these goods resulted in making them great favorites for electrolytic and other work where load fluctuations are so violent that the needle on the ordinary type of instruments would soon be broken.

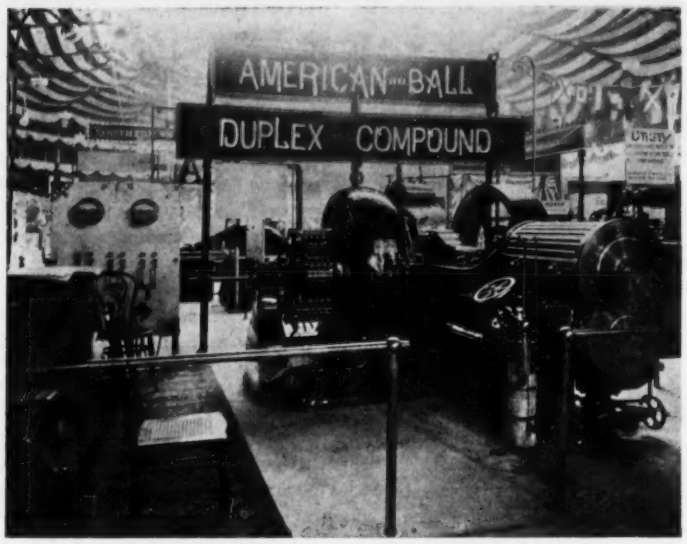
Their exhibit of portable instruments is extensive and instructive. All kinds of voltmeters, amperemeters and ohm meters for direct and alternating current are shown, and there are some very ingenious watch pocket devices which have proven very popular among battery users. One of these is of the type specially suitable for the use of telephone companies and consists of an ingenious adjustment of parts, so that the instrument shows the current which the battery to be tested is capable of passing through a standard transmitter resistance as well as the voltage which it is applying to do this.

EXHIBIT OF MACHADO & ROLLER.

There are further some new Wheatstone bridges which are very ruggedly made and which are said to contain galvanometers whose sensitiveness is surpassed only by laboratory devices with fibre suspensions. An attendant is constantly at hand to explain details to any interested parties.

American-Ball Engine Co.

The American-Ball Engine Co., of Bound Brook, N. J., has an exceedingly interesting exhibit at the eastern end of the Garden, in charge of Mr. Frank Ball and his staff. It comprises a lighting unit driven by his new duplex compound engine, furnishing a large number of lights within the exhibit and in the vicinity. The smoothness and steadiness of operation are a constant surprise to the

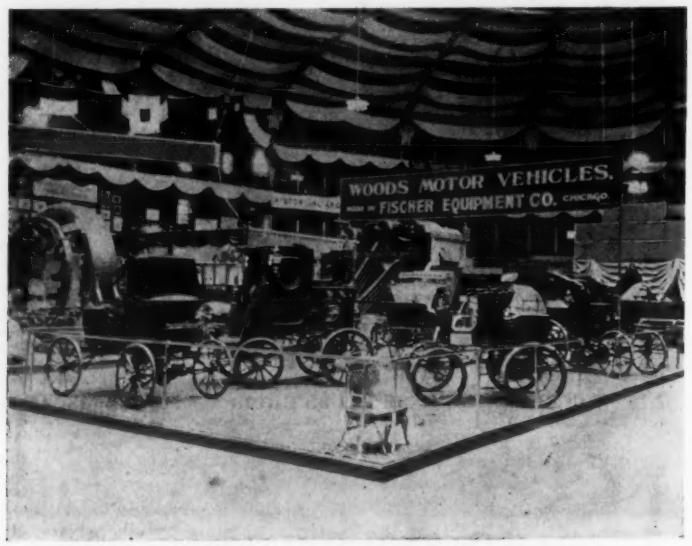


THE AMERICAN-BALL ENGINE.

visitors. A full description of this new engine and its features will be found in a separate article elsewhere in this issue.

The Woods Motor Vehicles.

A large central and conspicuous exhibit is that of the Woods Electric Vehicle Co., of Chicago, opening on four aisles, and containing several handsome automobiles that have elicited warm praise and admiration from the public. One of the leading features is the hansom cab, with motor on the rear axle; the road wagon with top, the stanhope, the brake, the park trap and the coach delivery wagon. The park trap shown is that owned by Mr. Samuel Insull, in whose service in Chicago it has made over 8000 miles. The Fischer-Woods carriages are more or less familiar to our readers,



WOODS MOTOR VEHICLES.

having been described in these columns. There are two independent motors for driving, dust and waterproof, with rawhide pinions. The front axle has steering knuckles and arms with ball bearings made to turn at an angle of 45°. The running gear and axles are made of solid metal, and the wheels are rubber tired with ball bearings. The brake so interacts with the motor as to be operated by the same lever that works the controller, and three speeds are managed with the lever that thus applies the brake. The removal of a key from the reversing switch locks the vehicle when not in use. The batteries are cased in hard rubber cells sealed. The running capacity is given at from 50 to 75 miles per day, subject to charging facilities and duplication of battery. Mr. I. H. Kuh is in charge of the exhibit.

Exhibit of Grinding and Polishing Machinery.

The Niles Tool Works, 136 Liberty Street, New York, makes an exhibit of machines and wheels for grinding and polishing, the invention of Mr. Edward Wood, of Newark, N. J. One of these polishing wheels is direct connected to the spindle of a 3-hp shunt wound motor of the General Electric type C. E. The polishing belt is of elastic material and is applied to the wheel as a tire is applied to a wagon wheel. The centrifugal force due to the rapid rotations of the wheel cause the belt to expand and become perfectly true on its cutting,or outside surface irrespective of any unevenness which may exist when the wheel is at rest. In other words the wheel is trued automatically. The exhibit also shows a bench machine for grinding and polishing cutlery and bicycle pedal plates; a machine which on one side polishes flat, steel strips, and on the other polishes brass tubing. There is also shown a machine for polishing hammer heads and one for making bicycle hubs. The latter machine turns out 50 hubs per hour out of the rough, all ready for plating. A

EXHIBIT OF THE NILES TOOL WORKS.

portable machine for grinding plated surfaces is also exhibited, together with a line of steel pulleys. All of the machines shown in this exhibit are belt-driven, being connected to General Electric motors, in capacities ranging from 3 to 5-hp. There is one exception to this, however, in the case of the polisher first referred to, this machine being direct connected as already stated. Mr. F. H. Gottlieb is in charge of the exhibit.

Export Night at the Garden.

The growing magnitude of the electrical export trade has deservedly attracted notice, and it tends more and more to become one of the largest contributors to the statistics furnished by American manufactured products going abroad. Sir Robert Giffen, the English statistician, has just recently remarked on the incessant changes that take place in foreign trade, one thing taking prominence and then another; and anyone who studies the conditions can see that electricity, by the mere force of events, must come to take a large place in the list of our exports. With this idea in mind, and realizing that an exhibition is a forcible means of attracting general public attention, the Electrical Exhibition management organized a committee last week from among the exhibitors and in their behalf invited some 50 of the foreign consuls, as well as several of the leading export merchants in this city, to visit the exhibition on Friday ,May 19. Mr. H. L. Shippy was appointed chairman of the committee, and the invitation was availed of generally by those for whom the affair had been organized.

Convention of Railway Telegraph Superintendents.

EXHIBITS AND EXHIBITORS.

The Edison phonoplex system of telegraphy was represented by Mr. W. S. Logue.

The Railway Manifolding Company, of Chicago, Ill., was represented by W. F. O'Connor.

W. W. Young, 43 Cedar Street, New York, represented the Union Switch and Signal Company, of Swissvale, Pa.

Robert W. Welch, of Trenton, N. J.; represented John A. Roeblings Sons Co., manufacturers of wire, wire rope, electric wires and cables.

Mr. William Marshall, of New York, the well-known condenser manufacturer, was present, met many old friends, and made a great number of new ones.

The Manufacturers and Inventors Electric Company, 96 Fulton Street, New York, had a number of its Morse Secret Sounders on exhibition. They were carefully examined and favorably commented upon by those interested.

Mr. Wendell Baker, special agent of the American Telephone and Telegraph Company, New York, showed diagrams of private branch exchanges of the long distance telephone equipment in its connection with the railroad service.

The Safety Insulated Wire and Cable Company, New York, was represented by Mr. A. P. Eckert. A full line of samples of telegraph, telephone, electric light wires and cables was exhibited. A section of the Philippine submarine cable, of which the Safety Company manufactured over two hundred miles to connect the islands of the Philippine Archipelago for the War Department of the United States, attracted general attention.

The Parrish Signal Company, of Jackson, Mich., was represented by A. F. Hovey, electrical engineer of the company. A working model was shown demonstrating the feasibility of open circuit street and highway crossing signals, working automatically. The advantages of having a signal that a hand car will not operate and that a man cannot maliciously start were emphasized. Photographs of some of the recently installed signals were attractively shown.

The National Conduit and Cable Company, New York, manufacturers of paper insulated cables, and of wrought iron cement lined conduit, was represented by W. S. Eckert. Samples of telegraph, telephone, electric light and power cables were exhibited together with samples of conduit. Underground electrical construction is now being favorably considered by railroads, consequently, Mr. Eckert's exhibit proved to be most interesting to the superintendents.

Mr. C. E. Egan, general manager of the Inter-State Telephone and Telegraph Company, was present and extended many courtesies to the visitors. Mr. Egan's company is now building long distance lines connecting their exchanges at Roanoke, Va., Winston,, Durham, Raleigh, Goldsboro and Wilmington, N. C. A number of gentlemen, old friends of Mr. Egan, when he was in the telegraph business enjoyed a tug ride of several hours on the beautiful Cape Fear River.

Mr. Eugene W. Vogel, signal engineer of the Railroad Supply Company, Chicago, showed a full sized model of the Chicago Crossing Signal, a highway alarm. The type exhibited was of the closed circuit system so that the public and the repair men get notice in case anything on the signal becomes disarranged. It rings also a large gong at the crossing. This signal has an electric light which illuminates while the train is approaching. The whole signal consists of a relay and bell with minor sundry materials, the same materials and relay can be used on either open or closed track or wire circuits, and is very simple and similar to an ordinary sounder.

The Telephone Manufacturing Company, of Sumter, S. C., exhibited a number of its "Imperial" telephones equipped with its long distance transmitters and new generator, the latter attracting much favorable comment and criticism. The fine finish of the woodwork of these telephones was a feature adding much to the general appearance of the exhibit. Mr. F. C. Manning, vice-president of the company, had the exhibit in charge and stated that his company is now manufacturing everything that enters into the construction of its telephones. This company also exhibited parts of its several types of switchboards and other exchange apparatus and showed many photographs of exchanges recently equipped.

Ericsson Telephone Company.—The exhibit of the Ericsson Telephone Company, of New York, consisted of a Swedish desk set with a 25,000-ohm generator; a standard American pattern desk set; a Swedish imported wall set in oak finish; combination wall and desk set without hook in the magneto; Swedish imported hand micro-telephones; Swedish imported knuckle joint operator's head gear and receiver; interior set for either wall or desk; Utica Drop Forged and Tool Company plyers, Swedish plyers; the hookless wall and desk set, which has absolutely no hook in the magneto bells; water and moisture proof transmitters, specially adapted for railroad work. This company was represented by Messrs. John F. Hemenway and L. P. Smith.

Messrs. J. H. Bunnell & Co., 76 Cortlandt Street, New York, was represented by Mr. Charles McLaughlin and J. J. Ghegan. Their exhibit consisted of a complete set of Weiny-Phillips repeaters in operation on lines furnished by the Western Union Telegraph Company, Twentieth Century portable testing sets; 150-ohm main line relay combination sets; standard main line relays; steel lever keys; new style switchboard; wrecking railroad telegraph set; carbon point railway crossing signal bell; standard Western Union spring jack switch; Mascot dry batteries; also Whitney pocket volt and milliampere meters. Messrs. Bunnell & Co., distributed as souvenirs handsome leather card cases especially made for the occasion. They also distributed celluloid memorandum tablets bearing the same design.

NOTES OF THE CONVENTION.

The lecture by Mr. William Maver, Jr., of New York, on wireless telegraphy proved so interesting that he repeated it before the Y. M. C. A., of Wilmington, N. C.

Mr. Thomas A. Edison, who mingled freely with the delegates during the entire convention, was the great attraction wherever he went. It is needless to say that Mr. Edison enjoyed the few days recreation.

Among the side trips was one to the Atlantic Ocean, ten miles from Wilmington, where the Atlantic Yacht Club threw open its doors to the delegates. Bathing suits were provided and a dip in the ocean was enjoyed.

The members of the association on invitation of H. W. Pope, the traffic superintendent, visited the new exchange of the Bell Telephone Company, at Norfolk, Va. This plant is the latest installed of any in the United States and is up-to-date in every particular.

Mr. George L. Lang, presented to Mr. Thomas A. Edison on behalf of some members of the association a valuable oil painting entitled "Alligator Bait." The picture represented a dozen typical southern darkies ranging from three to seven years of age in the costume provided by nature. Mr. Edison had been so liberal in the distribution of souvenirs that it was thought fitting to present him with one that would be a perpetual reminder that he had met with the Association of Railway Telegraph Superintendents.

A silver basket was presented to Mr. and Mrs. W. F. Williams by Secretary Drew in behalf of the association. Mr. Drew touched upon the kindness and hospitality shown by the people wherever the delegates visited. In closing his remarks he said that the present was made in behalf of the association to the chairman of the entertaining committee, Mr. Williams, who had left no stone unturned to afford everyone a good time. On the bottom of the basket was engraved "To Mr. and Mrs. W. F. Williams, of the S. A. L., by the Association of Railway Telegraph Superintendents." On the face, the initial of Mr. and Mrs. Williams was engraved.

The Telegraph and Telephone in Madagascar.

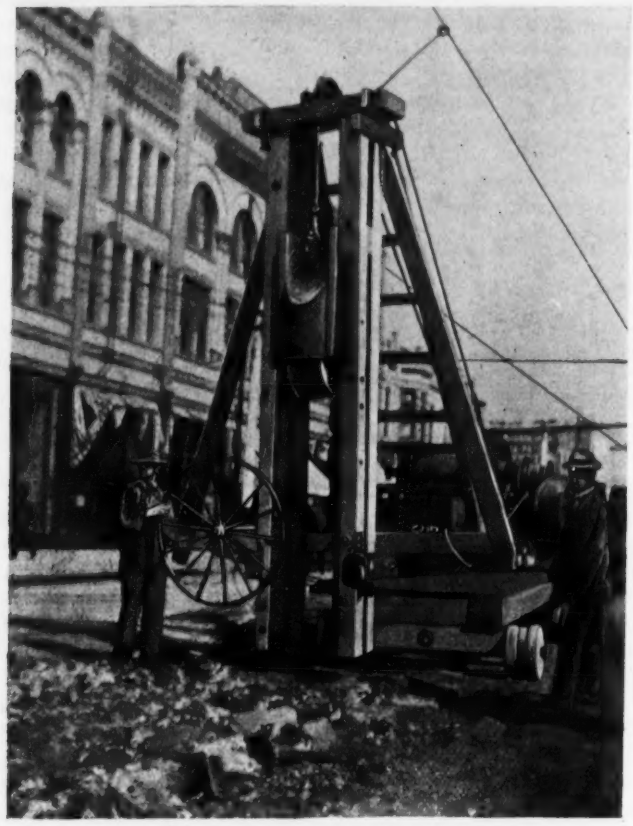
United States Consul Gibbs, at Tamatave, Madagascar, gives some information regarding telegraphs and telephones in that island. The Morse open-circuit system is used there and the messages are received on tape. There are about 1200 miles of wire at the present time, and the system is being increased. The telegraph connected with the Post Office Department is controlled by the French government. It is not thought possible to introduce any improved system of telegraphs into Madagascar owing to climatic conditions. The present system is out of order about one-third of the time. There is a telephone (Ader) system used principally by the government offices. Business does not demand its general adoption by the commercial houses and Consul Gibbs does not think the conditions propitious for the successful establishment of telephone exchanges.

A Trolley Battering Ram.

By R. G. Miller.

The accompanying illustration shows a concrete breaking machine recently in service in Los Angeles, Cal., in breaking up the concrete in the old cable tracks previous to relaying with new rails. It is similar to a pile driver, and just high enough to go under the trolley wire with which electrical connection was made. The weight was lifted by a drum or ordinary hoist, operated by a 10-hp motor getting its power from the trolley wire. The hammer, which had a drop from 8 to 10 feet, weighed 2500 pounds and the wedge 200 pounds.

The wedge is of steel and connected to the hammer by dowel pins.



ELECTRIC CONCRETE BREAKER.

It is 12 inches by 10 inches on the face next the hammer and 14 inches deep. The motor, drum, and hammer are supported by a frame work mounted on rollers, which was moved ahead by its own power by means of a rope attached to the yokes of the cable track. The hammer is moved laterally by the wheel shown at the left. The machine broke from 320 to 350 feet of single track in a day of ten hours.

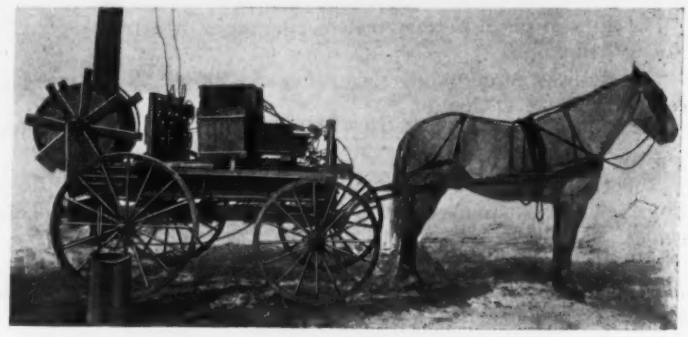
Thawing Frozen Water Pipes with Electricity.

By R. Baker.

Though somewhat late for application the present season, the following information concerning the electrical thawing of water pipes may interest your readers.

The accompanying photograph was taken in the residence portion of Little Falls, Minn., where a 6-inch main was frozen between three hydrants, a distance of 640 feet. The thawing was started at 8:30 a. m. between Nos. 1 and 2, with 23 amperes primary current, the primary voltage being 1000 and the secondary, 100. At 11 a. m. the water began to flow from No. 2, and at 1:30 p. m. the water flowed with full force from both No. 2 and No.3.

Several connections between the main and hydrants having a length of 12 feet of 6-inch pipe were similarly thawed out, the time ranging from 1 to 1½ hours, and residence service pipes have been thawed in from 18 to 35 minutes. One of these latter was 350 feet long and another 400 feet, both of 1-inch pipe, the time in each case being 35 minutes. In an office building 200 feet of 1¼-inch pipe were thawed in one-half hour's time. The outfit, which is shown in the accompanying illustration, consists of three 100-light and two 75-light transformers, which are so arranged that any number can be used at a time, or all together. Either a 50-volt or a 100-volt secondary is used, and a water resistance when



ELECTRICAL THAWING OUTFIT.

necessary. Four sections of No. 000 wire, each 200 feet long, were carried, and connected wtih close-fitting couplings, thus enabling the apparatus to be set up and working in 30 minutes.

A New Automatic Knife Switch.

A knife switch which may be operated from any distant point

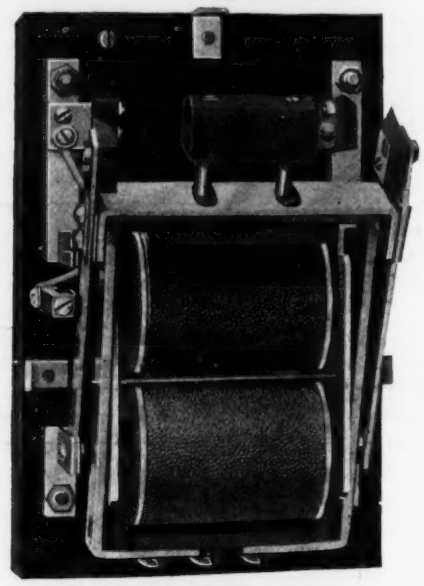


FIG. 1.—AUTOMATIC SWITCH.

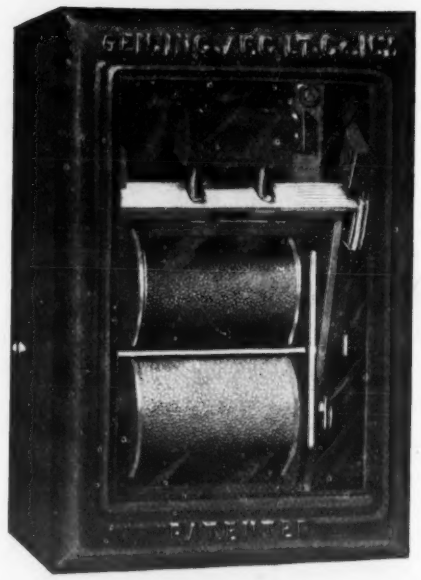


FIG. 2.—AUTOMATIC SWITCH, WITH CASE.

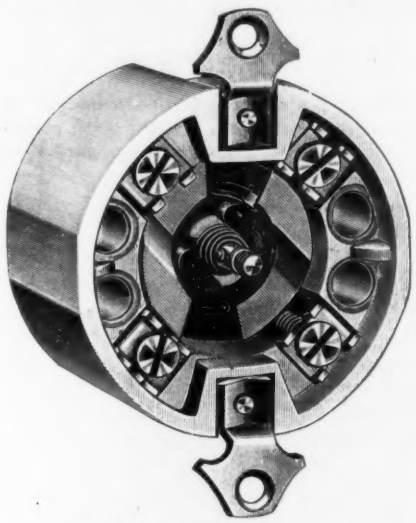
offers distinct advantages. Its adaptability for different classes of light and power work and its availability for fire and burglar alarm,

motor work, automatic pump control, house wiring, railway signals, etc., results in a very material saving in copper, besides solving many problems of rapid and effective electrical control and operation.

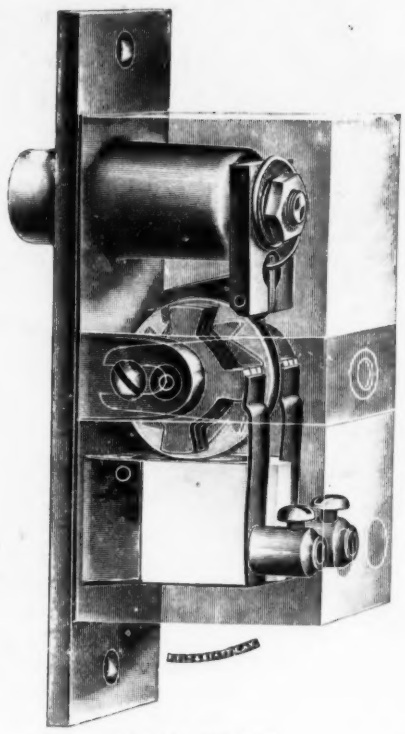
The essential feature of an automatic action in any mechanical or electrical apparatus is reliability. In designing the automatic switch illustrated herewith, the General Incandescent Arc Light Company of New York, has kept this point clearly in view and has embodied in the construction of the switch a number of novel mechanical features, each of which aids in giving a reliable and positive movement, while solenoids, springs, gravity catches, etc., have been eliminated with the same object in view.

The Eco Door Switch.

Edwards & Co., of New York, have just put on the market the Eco door switch, the invention of Mr. Adam Lungen. It is intended for telephone booths, toilets, etc. The object obtained is, that an incandescent lamp is alternately lighted and extinguished by the opening of the door. If a telephone booth having an incandescent light inside is fitted with this switch, when the door is opened contact is established and the lamp is lighted and it stays alight while the booth is in use. When the door is opened to come out the light is extinguished, and when the door is closed after exit, still there is no light.



GANG FLUSH SWITCH.



ECO DOOR SWITCH.

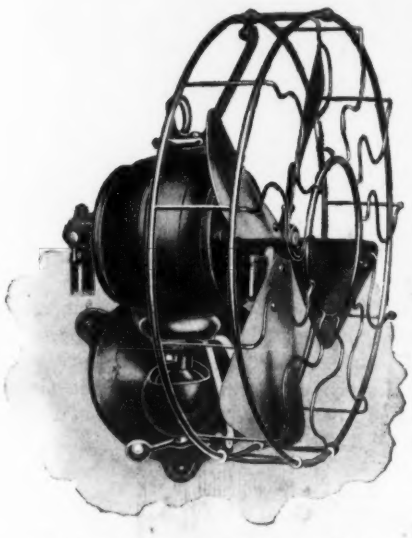


FIG. 1.—LUNDELL SIDE-WALL MOTOR.

This contrivance has been approved by the National Board of Fire Underwriters. It is provided with a porcelain cover and porcelain insulation. The size of the mortise required for this switch is 2¾ inches long, 1 inch wide and 1⅝ inches deep. The size of the front plate is 3¾ inches by 1 inch, so that it can be used in any door frame. The carrying capacity for 110-volt circuits is 5 amperes.

Perkins Gang Flush Switches.

A new line of flush switches has just been put on the market by the Perkins Electric Switch Manufacturing Company, of Hartford, Conn. Users of, and dealers in these goods will find this line exceedingly convenient. The switches are made in 5 and 10-ampere sizes, and are single pole, double pole, three-point and four-way. These various kinds of switches are all put up in porcelain cups, the sizes of the cups being the same for each of the different switches. These cups can be used singly on the flush plate, and they can also be mounted in gangs as required. Frames to hold these switches for gangs are carried in stock and can be furnished with the face plates independent of the switch. All of the switches are interchangeable to position in the gangs so that the dealer who has a stock of frames and plates, also switches, can immediately make up any gang required. All the working parts of the switch are protected by the porcelain cup. These switches wire from the front.

Lundell Fan Motors.

Not many years ago fan motors were looked upon as ingenious toys rather than practical and useful devices for promoting the comfort of mankind; now, however, they are generally regarded as a necessity. At first little attention was directed to securing a compact, economical and artistic design, nor was much attention given to the question of efficiency, but now as much skill is applied in the construction and design of these small motors as upon the larger power machines. Much attention is given to simplifying and standardizing the parts, also to efficiency and economy in operation, since these are important features as viewed from standpoints of the dealer and the central station supplying the current.

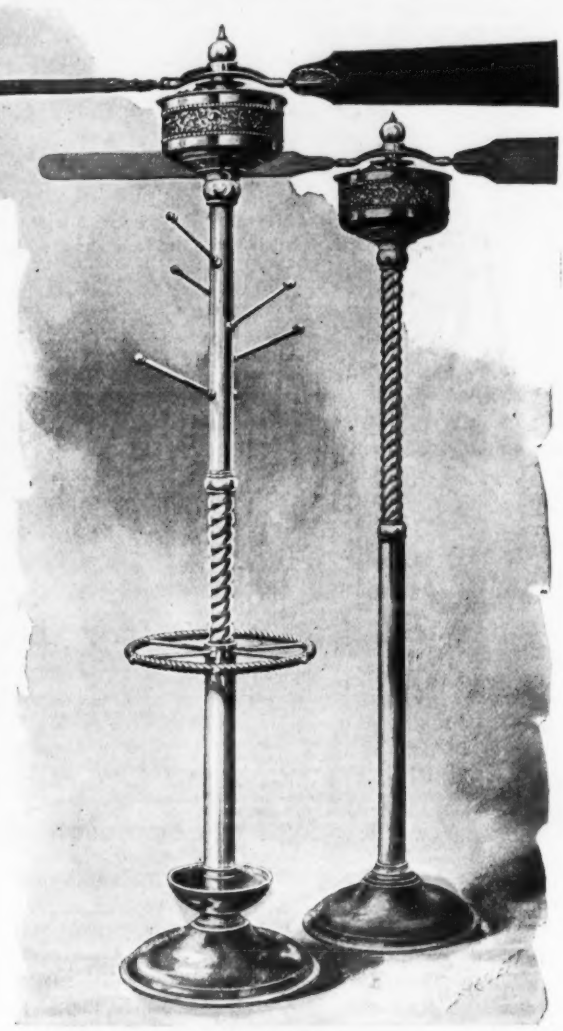


FIG. 2.—COLUMN FAN MOTORS.

Fig. 1 of the accompanying cuts shows a pattern of Lundell motor for fastening against a side-wall, and Fig. 2 illustrates the Lundell column fan motor. The latter is intended to stand on the floor and is said to be meeting a popular demand on the part of the larger and best restaurants in New York City and elsewhere. The Sprague

Electric Company, 20 Broad Street, New York, is manufacturing the various types of Lundell fan motors and has published a handsome catalogue illustrating the various sizes and patterns, a copy of which may be had on application.

Rushmore Projector.

Formerly there were no searchlights in use in the merchant marine except a few makeshift affairs with cheap sheet metal reflectors which were both unreliable and unsatisfactory. In 1894 the Rushmore Dynamo Works, of Jersey City, N. J., brought out their high power lens mirror projector, and now can refer to over four hundred prominent merchant and naval vessels in all parts of the world carrying their apparatus. They state that they have orders on their books for over thirty projectors, and that their projectors are specified for many important yachts and steamers now building.

The illustration herewith shows a 26-inch Rushmore projector as extensively used on government vessels and large ocean liners, fortifications, etc. A dozen other forms are furnished with all forms of distant controllers, for mounting on the roof of pilot house, on mast head, etc., and also special types for fine yachts.

The Rushmore Works make their own lenses. They now have in constant use seven large lens machines, each of which cost several thousand dollars to build. The extent to which searchlights have entered into the mercantile marine and for pleasure yachts is forcibly demonstrated by the facilities now required for their manufacture.

26-INCH PROJECTOR.

A New Type of Compound Engine.

One of the interesting features of the exhibition now being held at Madison Square Garden is a new type of engine designed by Mr. Frank H. Ball and his son, Mr. F. O. Ball, of the American Ball Engine Company, and named the "Duplex Compound." A compound engine taking up the same floor space as a simple engine and having practically no more working parts is a novelty that has not failed to draw every visiting engineer to the American Ball booth, where the engine is in operation driving a six-pole Ball direct-current generator. Referring to Fig 1, it will be seen that the engine has the appearance of the ordinary simple engine, but with a cylinder added beneath the usual one. The greatest peculiarity of the engine, however, lies in the use of a single steam chest, a single valve and valve gear, and but one crosshead. As will be seen, the pistons are as accessible as in the case of a simple engine, and the arrangement of the cylinders and valves not only gives an excellent steam distribution, but insures a minimum of condensation losses in both cylinder and receiver, the latter being merely the exhaust space to the valve.

The arrangement of pistons and crosshead will be understood by reference to Fig. 2. The crosshead is designed with a view to securing the greatest strength and rigidity with the least weight. The length is made equal to twice the length of the stroke so that the smoothness of running is quite independent of any unequal division of work between the pistons, if such should occur. Owing, however, to the fact of the simultaneous cutoffs in both cylinders, the work is almost exactly divided between the two pistons at all stages of the load, from friction load to the fullest overload capacity. The single valve, which is three-ported, has, of course, but one valve stem, and its events are regulated by the usual form of shaft governor used on the Ball engine.

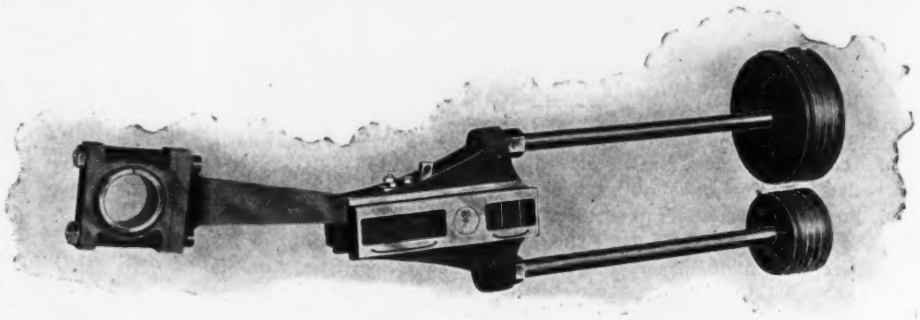


FIG. 2.—PISTONS AND CROSSHEAD OF DUPLEX COMPOUND ENGINE.

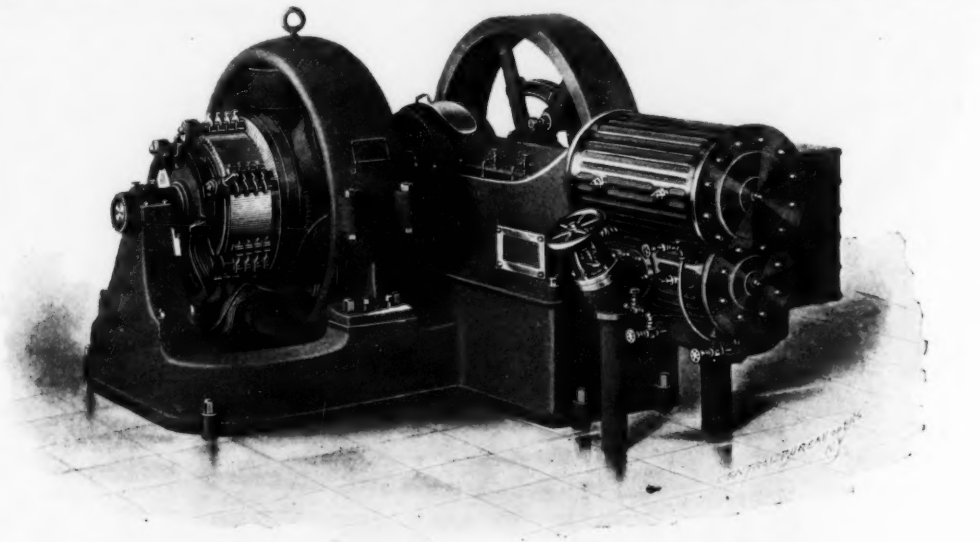


FIG. 1.—DUPLEX COMPOUND ENGINE.

The indicator diagrams in Fig. 3 were taken from the engine on exhibition at Madison Square Garden. The features of special interest in these diagrams are the constant receiver pressure under varying loads, and the equal division of work between the pistons under these conditions. As will be seen from the data given below the cards, the work at three stages of load between 38-hp and 85-hp is almost exactly divided between the two pistons. Practically the same thing is true of lighter and heavier loads than those shown.

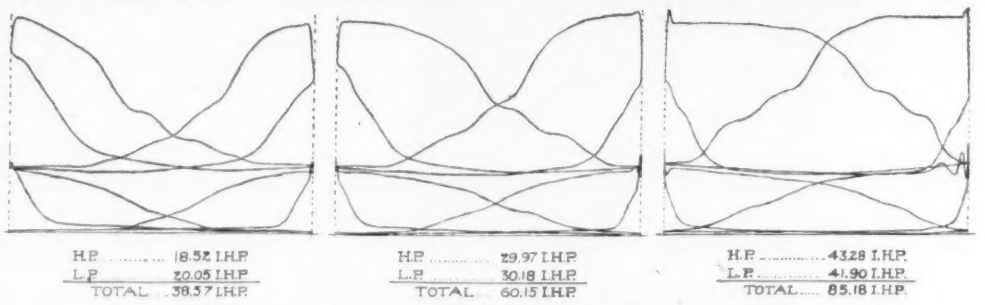


FIG. 3.—INDICATOR CARDS FROM DUPLEX COMPOUND ENGINE.

Electric Motors for Operating Printing Presses.

The Kansas City *Star* and the Union Bank-Note Company, of Kansas City, Mo., have recently installed an electric power equipment. Each of the *Star's* five large double Hoe presses, having a combined capacity of 120,000 papers per hour, is driven by a 35-hp slow-speed, multipolar direct-current motor, operating at 220 volts. In connection with each motor a 20-hp Cutler-Hammer speed-regulating rheostat is used. The rheostats stand on the top of the presses and from each a circuit, in which a number of switches have been placed, extends to all parts of the press. By opening any one of these switches the automatic attachment is thrown and the press is quickly brought to a stop. The Union Bank-Note Company has a complete electric plant, consisting of an Ideal engine and direct-connected Lundell generator, and motors ranging from one-quarter to three horse-power, all direct-connected to presses on the different floors. Controllers and rheostats give all the desired variations of speed from 75 to 1800 revolutions per minute on the different presses. These equipments were installed by Messrs. Hodge, Walsh & Loring, of Kansas City.

New Jenney Motor.

The accompanying cuts illustrate a new type of motor recently placed on the market by the Jenney Electric Manufacturing Company of Indianapolis, Ind. On account of the construction of this motor it has been styled as "Universal type." Fig. 1 shows the motor mounted in the usual manner with the supporting base on the under side and with standard pulley on armature shaft. Fig. 2 shows the motor belted to the side of post, and with back gear.

It will be observed that the frame of the motor is spherical, and provided with two circular bands which are turned true to guage, and drilled uniformly all around the bands to enable the supporting foot to be attached at various angles, that motor may be attached to the ceiling or a side wall, either right or left-handed, and at various

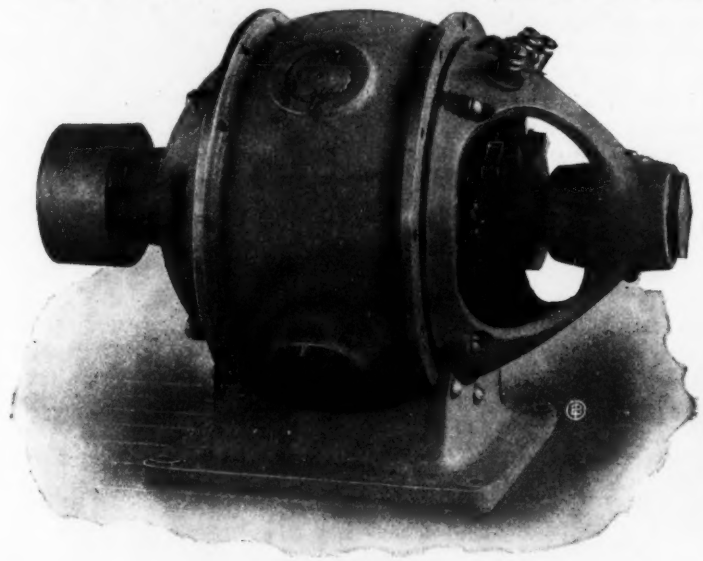


FIG. 1.—NEW JENNEY MOTOR.

other angles. The bearings for the back gear are also drilled so that they can be attached to the body of motor frame at any position desired.

The makers claim for this arrangement the great advantage that a very slow speed can be obtained from the back gear shaft with a comparatively small motor, which results in the cost of outfit being very much less than is the case where a large motor frame is wound to obtain slow speed; the efficiency of the motor is also very much higher. The manufacturers also call attention to the fact that the supporting foot can be made in any special shape desired to enable the motor to be coupled to special machinery.

The back gear enables slow speed to be obtained directly from the motor, without the necessity of a countershaft and the extra belt, which are expensive as well as troublesome to maintain. Where the motor is to be installed in dirty places and exposed to flying particles, the heads are entirely housed.

These motors are multipolar, having four poles, and are constructed with wrought iron field cores, and have the slotted core type of armature. The armature windings are form-wound and insulated before being placed on the armature. The parts of this machine are interchangeable and the bearings self oiling. These

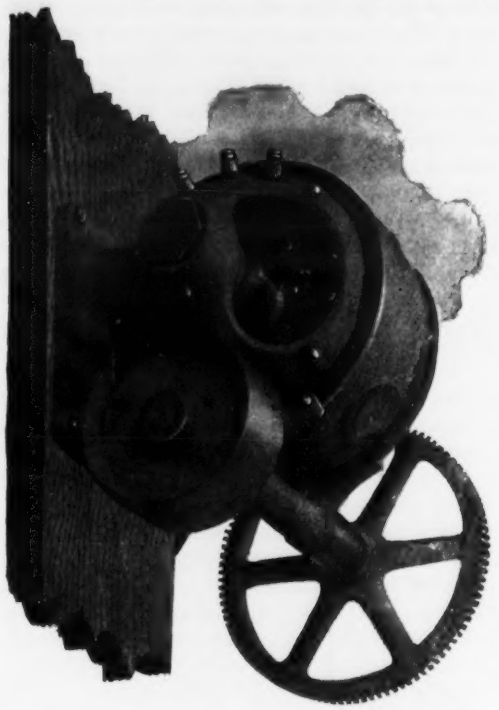


FIG. 2.—NEW JENNEY MOTOR.

machines are now made in sizes from ½ to 5-hp inclusive, for both moderate and slow speeds and for all standard voltages.

A New Electric Bell.

The bell illustrated herewith of the monitor type and constructed on a new principle, has recently been placed upon the market. The armature is pivoted and operates on the gong through the medium

BELL MECHANISM.

MONITOR ELECTRIC BELL.

of a pivoted hammer, the make-and-break being arranged between the end of the armature lever and a point on the hammer lever. By this arrangement, the bell is struck on its side, which gives the best ringing effect. The hammer swings through a long arc, giving a length of stroke which is said to be double that of any other form of bell on the market. The force of the blow is thus principally dependent on the stroke of the armature and not on the weight of the moving parts. Owing to the light weight of the hammer, and its consequent low inertia, it quickly returns to its normal position. Another important feature of this bell is the sliding contact. The contact points slide over a distance, on a maximum amount of battery, of not less than 3-16 of an inch. This insures clean surfaces and prevents the burning of the point.

This bell, which is manufactured by Rousseau's Electrical Works, 329 Fourth avenue, New York, is designated as the "Type Q" sliding-contact electric bell.

Modern Drill Grinding Practice.

It has come to be a recognized fact among the highest mechanical authorities of the day that the twist drill must be ground in a special machine. The best hand grinding is too crude and costly in its results. While it is easy to grind a drill so as to bore a hole, yet it is impossible to grind it twice so as to bore holes of exactly the same size, even by the best workmen. Machine ground drills, however, are accurate when properly ground.

Figure 1 represents a drill with the point 1-16 of an inch out of the center. Figure 2 shows the variation in the size of a hole bored with a drill ground mechanically correct, and with a drill having its point at one side, as shown in Figure 1. While the variation is not always double the amount of error, it is always more than the

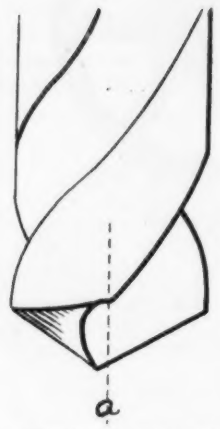


FIG. 1.—ECCENTRIC DRILL POINT.

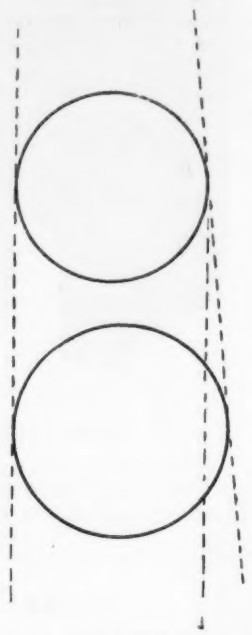


FIG. 2.—VARIATION IN SIZE OF DRILLED HOLES.

error, depending on the sharpness of the point, etc. Hand-ground drills are, therefore, only fit for the roughest work, and manufacturers desiring to do close, accurate work, are compelled to use a drill grinder.

Machine-ground drills possess other compensating features besides that of always boring holes of exact size. With both lips cutting, a drill will run about twice as long without regrinding, thus materially saving workmen's time, taking only half the power, and fully doubling the life of the drill.

The firm of G. T. Eames Company, Kalamazoo, Mich., to whom we are indebted for the above details, manufactures a grinding machine for the purpose mentioned, as well as punching and shearing machinery, mandrel presses, etc.

"Diamond H" Push Button Switches.

The main points considered by the makers in the construction of the type of switch shown in the accompany illustrations—known as the "Diamond H" switch—has been, they state, positive mechanism and good contacts with good wearing qualities of both; perfect insulation of the current carrying parts, both between the terminals and from the other metal portions of the switch; ease and uniformity of movement and simplicity of mechanism. A lengthy description of the switch is unnecessary, but a few details of construction will be of interest to those whose experience with switches of this type has not been entirely satisfactory. The accompanying illustrations show the switch details.

Fig. 1 shows the switch as a whole with a solid brass face plate. The ears for attaching the switch to the wall or woodwork are recessed in the back of the face plate, avoiding the necessity of cutting a recess in the wall for them. Fig. 2 shows a 10-ampere double-pole switch with face plate removed. The mechanism and contacts are enclosed in a porcelain base, shown with the front and side cut away. The switch plates, one of which is shown in the cut, are of the knife-switch pattern, and owing to the device for driving it into and out of the contact clips, a high velocity and consequently a short arc are assured. The contact, Fig. 3, is of phospher bronze attached to a brass upright which carries the binding screw. This clip is comparatively long and wide, which insures flexibility and firm pressure upon the end of the switch plate. The spring, Fig. 4, is a simple coiled spring of comparatively large diameter made of steel music wire, with upturned ends to engage the moving parts of the switch. It is so used that no unnecessary

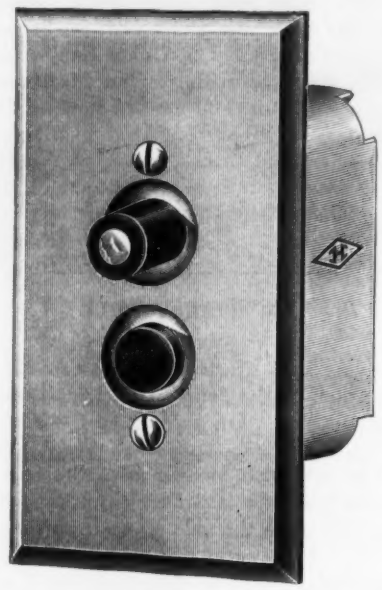


FIG. 1.—10-AMPERE, SINGLE-POLE PUSH SWITCH.

strain is put upon it. The insulation of the current carrying parts is effected by spools made of sheet mica, laminated, and held together by a central bushing. This spool is shown in section in Fig. 5. It is loosely mounted in an elongated opening in the switch plate, and is driven by a pin through its central opening. The body of the spool is surrounded by a steel sleeve, thus preventing the edges of the opening in the switch plate from cutting the mica. Mica, being a practically perfect insulator, a non-absorbent of moisture and unaffected by changes of temperature, is by far the best material that can be used for this purpose. The movement

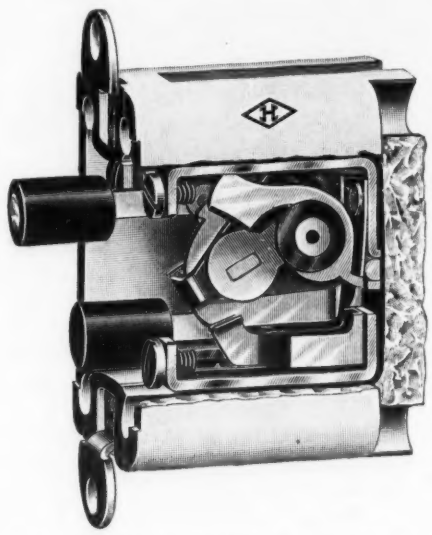
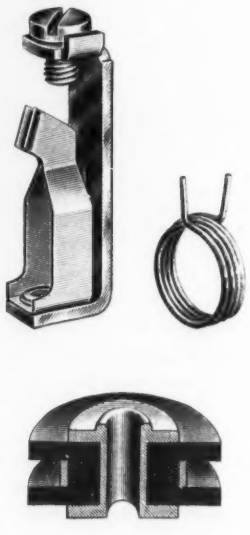


FIG. 2.—10-AMPERE, DOUBLE-POLE SWITCH.

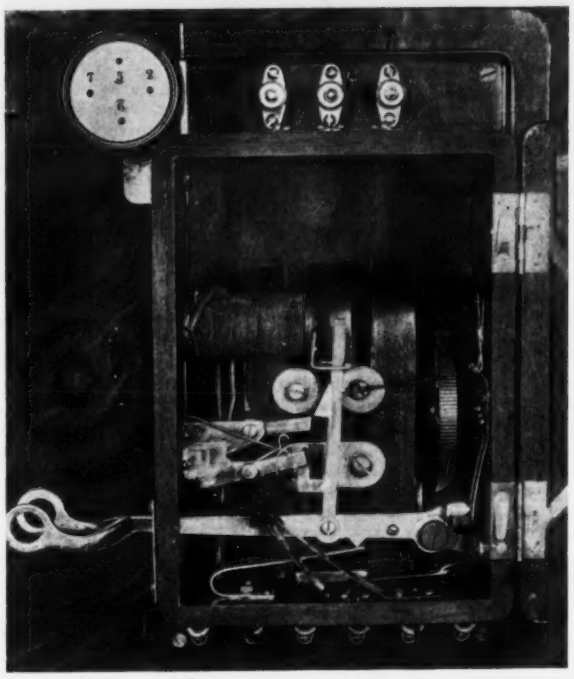


FIGS. 3, 4 AND 5.—DETAILS OF SWITCH MECHANISM.

of the buttons is smooth and the pressure required is uniform throughout their travel and nothing else has been sacrificed to secure this end. Details of less importance than these referred to, have been carefully considered and the result is a switch, which the manufacturers, The Hart Manufacturing Company, Hartford, Conn., guarantees as thoroughly well made, reliable and satisfactory in every way.

A Novel Telephone Call Register.

Mr. H. T. Richards, of New York City, has recently been granted a patent on a telephone register, which presents some new and valuable features. The object of this invention is to record electrically completed telephone calls simultaneously at the central office and the subscriber's station at the time such calls are made. A register is placed at the subscriber's telephone in a position to be readily seen when operated, as shown in the accompanying illustration, and a corresponding register is located at the central office. When a subscriber is desirous of making a call he calls up central in the usual way. If the number required is not busy, the central operator before making the connections (tomatically to her plug or by a push-button), projects a current grounded at central office through the calling subscriber's register at central, electrically moving the registering mechanism one number ahead. The circuit runs thence through one of the wires composing the pair of the subscriber's circuit out to the subscriber's telephone. In the subscriber's telephone is a circuit breaker, which is normally open, but which is closed when the receiver is removed from the hook for purposes of conversation. While the receiver is off its support, the change of the position of this support puts in operative condition the grounded circuit from central, referred to, and locks the registering mechanism in the subscriber's telephone to the receiver hook or support, as shown, so that when the subscriber on finishing his conversation returns his receiver to its hook the downward movement of the receiver hook caused by the weight of the receiver serves to operate the subscriber's register. The registering circuit referred to,



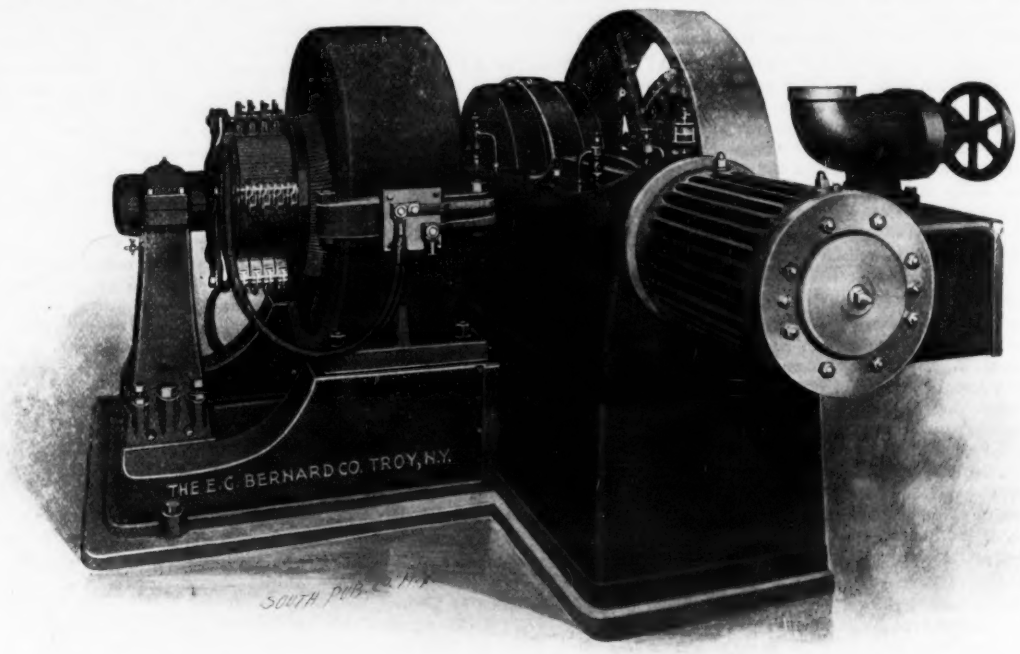
TELEPHONE CALL REGISTER.

It will be seen that by this method the central office and subscriber's register must agree, as any manipulation of the telephone hook on the part of a subscriber disables the register controlling circuit and renders the central office operator cognizant of the fact by the failure to operate of her electrically controlled register. Inasmuch as the subscriber's register can only be put in an operative condition when he is at the telephone, with his receiver off its support, the central operator will be unable to operate her register or his locking mechanism without his knowledge or in his absence. While central actually operates her register herself, the subscriber, by his own act, when returning his receiver to its support, registers his messages for himself. If central by mistake should lock his register to his receiver hook while he would have to register on returning his receiver to its support, he can call up central at the time the mistake is made and have same rectified. This system virtually resolves itself into a registration of messages depending on the mutual and definite acts of the telephone subscriber and the central office operator. It would seem to avoid trouble and dispute between exchange and subscriber, as well as a large amount of clerical work now necessary in message rate work.

Direct-Connected Multipolar Generator.

The direct-connected generator shown in the accompanying engraving is designed for high electrical efficiency without sacrifice of any of the properties upon which the smooth running of the machine under practical conditions is dependent. The mechanical features have received special consideration, the commutator being of generous size, the brushes having a large area of contact and the armature thoroughly ventilated through both longitudinal and radial openings. The bearings are self-aligning and self-oiling, easily accessible and of such a length as to obviate any possibility of heating.

The armature coil is constructed of disks of special non-hysteretic iron thoroughly tested and carefully annealed. It is of the ironclad type, the conductors being imbedded below the surface in insulating tubes made up of mica and oiled paper. The coils are machine wound, absolutely symmetrical and so arranged that no conductors cross having between them a high difference of potential. The commutator is also ventilated and is fully 20 per cent. larger than the commutator on usual types of similar machines of the same size. The brush-holder is of the reaction type and the brushes adjust themselves to a bearing with minimum friction, while at the same time they are kept in perfect contact with the holder. A brush can be easily replaced in five to ten seconds while the machine is in operation. The brush contact area is based on about 25 amperes per square inch of carbon brush, this being from 20 to 40 per cent. more than is the usual practice. The result of the care taken in design and in the selection of materials is a machine of slow speed and high efficiency, that will run sparkless and perfectly cool under normal load, requiring minimum of attendance, and will stand a more considerable overload than is usual with machines of the same efficiency. The manufacturer of the direct-connected generator described is the E. G. Bernard Company, Troy, N. Y.



DIRECT-CONNECTED GENERATOR.

NEWS OF THE WEEK.

Financial Intelligence.

ANOTHER AUTOMOBILE ENTERPRISE AT TRENTON, N. J.—The Electric Automobile & Manufacturing Company, capital $500,000, was incorporated last week to manufacture and operate electric vehicles. The incorporators are Charles P. Scott, of New York; Frederick W. Gaston and Edgar J. Runyon, of Elizabeth.

ADVANCE IN PRICE OF APPARATUS.—The General Electric and Westinghouse Companies have advanced prices of car equipments from $25 to $50 per equipment and advanced prices of generators 10 per cent. and other electrical apparatus in proportion. The reason given is the advance in the price of iron, steel and copper.

MEXICAN TELEPHONE.—The directors of the Mexican Telephone Company met last week and re-elected the officers of the company. Mr. Ezra H. Baker resigned as a director and Mr. Godfrey Morse was elected as his successor. The addition of Mr. Morse to the directorate of the company, it is believed, will result in the adoption, to a certain extent of his policy for the extension of the company's business by the creation of new capital.

ELECTRIC STORAGE BATTERY COMPANY.—The Electric Storage Battery directors have voted to allot to stockholders from the authorized increase in common stock 25 per cent. on their holdings as of date May 18, payment to be made in full at par between June 1 and 10. New certificates will be ready for delivery June 10. Transfer books close May 18 and reopen June 8. An insider in Electric Storage says: "The orders received by our company last month amounted to over $1,000,000. They came from all directions and included some large orders from the West.

SEVENTEEN VEHICLE COMPANIES.—Seventeen electric vehicle transportation companies were incorporated last week under the laws of New Jersey by the Whitney syndicate to operate automobiles in different states. Each company has an authorized capital of $100,000, except the one formed for the District of Columbia, which has an authorized capital of $6,000,000. The capital, with this latter exception, is supposed to be merely a nominal amount, to be increased later. The incorporators of each state are James E. Hayes, a Jersey City lawyer, and clerks in his office. The several states for which these companies are formed are Tennessee, Georgia, Ohio, Kentucky, New Jersey, Louisiana, Delaware, California, Michigan, Minnesota, Iowa, Maryland, Wisconsin, Indiana, Missouri, Virginia, and District of Columbia.

CHICAGO ELEVATED CONSOLIDATION.—President Carter, of the Chicago South Side, says that consolidation of the elevated lines is under discussion. If the roads go into a consolidation, the South Side interests will have to be well paid, as they are satisfied with their growing business. Eventually all may be leased by the Union Loop, but it will not be in the immediate future. The capitalization of the companies is $51,823,000. All of the local elevated roads are having the best business in their history. The Lake Street has opened its Oak Park extension and is carrying 30 to 50 per cent. more people than last year. It has never been able to earn more than fixed charges so far. The Metropolitan is doing better, and the South Side Elevated is selling close to par and earning about 4 per cent.

BROOKLYN RAPID TRANSIT.—A combination of the Metropolitan Street Railway system with that of the Brooklyn Rapid Transit Company, or what practically amounts to it, is being discussed by negotiators for both companies. A transfer agreement, similar to that now in operation between the Third Avenue and Manhattan Elevated roads, is the form which the proposition is most likely to take. The recent purchase by John D. Rockefeller of 40,000 shares of the Brooklyn Rapid Transit may have a bearing on the proposed arrangement with the Metropolitan. Eight million dollars, the amount of Mr. Rockefeller's holdings, gives him an important voice in that company's affairs, and it is understood that a block of Brooklyn Rapid Transit stock, most, if not quite as large as Mr. Rockefeller's has passed into the hands of H. H. Rogers, also of the Standard Oil Board.

CHICAGO STREET RAILWAYS.—The syndicate which has purchased Charles T. Yerkes' holdings of street railway stocks will put the entire amount purchased in the hands of the Illinois Trust & Savings Banks, as trustee, under a trust agreement lasting during the life of the lease of the two companies. The syndicate secures from Mr. Yerkes in round numbers one-third of the entire stock issue of the North Chicago and the West Chicago Companies. For this it pays the sum of $10,000,000. The syndicate is to form a corporation to which the stock will be transferred. A lease will then be made of all the lines owned or controlled by the two companies, under which West Chicago stockholders will be guaranteed dividends of 6 per cent. and North Chicago stockholders dividends of 12 per cent. a year. The Chicago Union Traction Company will be the name of the corporation to be formed. It will be organized under the laws of the state of Illinois, and it will have a capital of $32,000,000, of which $12,000,000 will be preferred and $20,000,000 common. The papers of incorporation will be sent to Springfield within a few days. No bonds will be issued. The total capitalization of the company will be represented in the $32,000,000 of preferred and common stock.

THE WEEK IN WALL STREET.—Most of the week was given up to a violent recovery in stocks, chiefly due to "covering" purchases of speculators. When this operation had been completed, which happened on Thursday, declines began again. Total sales of stocks on the New York Exchange last week were 3,048,009 shares, against 5,060,262 last week, and 1,787,104 for the corresponding week in 1898. The bond market has been considerably more active, with sales of $24,681,500 on the Stock Exchange, against $17,489,300 last week, and $9,243,300 for the corresponding week in 1898. The movement of prices has been quite uniformly upward, with a number of sharp advances. Government bonds have risen ⅛@⅜, sales on the Exchange footing up $124,000, against $204,000 last week, and $60,000 last year. Money has been very easy, with local rates on time loans and commercial paper slightly reduced. Call money at Chicago has eased off. During the week, 5048 shares of Western Union were sold, closing at 92. Of General Electric, 4825 shares were sold, closing at 118⅜. Metropolitan Street Railway, on sales of 48,000 shares, closed at 220. On the large sales of 440,700 shares Brooklyn Rapid Transit sold up to 115. In Boston, American Bell Telephone closed the week at 349½ and Erie Telephone at 94, Michigan at 95½, Mexican 3⅞ and New England 145. In Philadelphia, Electric Storage Battery, both common and preferred, were quoted at from 156 to 160. In Chicago, Metropolitan L pref. closed at 53¼. In New York, among the miscellaneous securities, Electric Vehicle pref. closed at 122 bid and common at 111. Electric Boat pref. closed at 44 bid and common at 25. New York Electric Vehicle Transportation closed at 28½ and New England at 12½. New York & New Jersey Telephone closed at 180.

CONTROL OF WISCONSIN TELEPHONE COMPANY.—The controlling interest in the Wisconsin Telephone Company has passed into the hands of the Erie Telephone management to-day, and Charles J. Glidden, of Lowell, Mass., has been elected president of the corporation. James P. McKinstry, of Cleveland, O., vice-president; Charles A. Grant was elected treasurer, and Geo. B. Perham, secretary. Mr. Henry C. Payne, former president, will remain on the board of directors, and a local treasurer and secretary will be appointed from the present clerical force. Mr. John D. McLeod will continue as general manager. The Wisconsin Telephone Company operates under the Bell patents exclusively in the state of Wisconsin and is one of the most valuable and best managed properties in the country. The capital stock is $1,200,000, with no indebtedness and $100,000 cash in the treasury. The company operates about 12,000 subscribers and 7000 miles of long distance lines, 35 exchanges, including Milwaukee, Madison and other large and important cities of the state. The headquarters are at Milwaukee, where the company owns a fine exchange building. Its real estate in the territory is valued at $129,000. Wisconsin is considered a valuable addition to the Erie system from the fact that it places under one management five states joined together, namely, North Dakota, South Dakota, Minnesota, Michigan and Wisconsin, the great grain-producting states of the world. The new acquisition will increase the Erie system to 76,000 subscribers and to about 150,000 miles of wire, with real estate valued at a million and a quarter dollars, located in 30 cities. The growth of the entire system will average at least 4000 subscribers monthly, and Erie will have at the close of the year in all probability 100,000 subscribers. The Erie board of management was elected an executive committee of the Wisconsin Company, and the policy of the company will be defined at meetings of the board held in Lowell. The company pays quarterly dividends at the rate of 7 per cent. per annum.

THE STATE OF TRADE.—Reviewing the situation R. G. Dun & Co. say: "Decline in stocks after the death of ex-Governor Flower was entirely natural. His personal influence was worth many millions to corporations which he chose to join. The stocks in which he was most largely interested were strongly supported, and after an hour's weakness began to recover, but his place in business will not be filled in an hour. No other occasion appeared for weakness in the market, and a very large share of the depression in industrial stocks had previously appeared on Tuesday, owing to the multiplication and highly magnified stories of new combinations in iron and steel. The official report of foreign trade in April showed a decrease, compared with last year, of $19,000,000 in the export of the principal products, but an increase in manufactured articles, and in that respect the month was only surpassed by March. The industrial stocks were at the top of speculation in these days, and the speculative demand for securities must hereafter always be distinguished from the legitimate business of the industrial companies as producers." Bradstreet's says: "The lesson conveyed by the April foreign trade returns is the immense value of the possession by this country of a large outlet for its surplus manufactures. Foreign takings of agricultural products are falling off, but larger takings of manufactured goods partially make up for this decline, brought about by improved agricultural conditions abroad. April exports as a whole fell off 11 per cent. from last year's totals, due to a drop of 31 per cent. in exports of breadstuffs, cotton, and provisions, because values of other exports increased 24 per cent. Less wheat, corn, and oats, but more flour, are being taken than a year ago, but values are lower for most cereals, and decreased takings of hog products and cotton are also features. For the fiscal year merchandise exports are slightly ahead of last year, but this gain is not likely to be held in the next two months, and last year's phenomenal export total will not be equaled. Exports still heavily exceed imports, although the balance is not as great as a few months ago, owing to enlarged takings of foreign goods."

BIG LIGHTING AND RAILWAY DEAL IN MASSACHUSETTS.—It is stated that Messrs. E. Rollins, Morse & Brother and Messrs. Tucker, Anthony & Company have acquired a total of 33 electric street railways and electric light companies in Massachusetts and Rhode Island, and that the consolidation will be known as the Massachusetts Electric Companies, an association which will be carried on outside of the general laws. The capitalization of the combined companies will not be less than $24,000,000, of which one-half will be 4 per cent. cumulative preferred stock and one-half common stock. Following are the companies which it is understood will be taken over: Lowell, Lawrence & Haverhill, Reading & Lowell, Lowell & Suburban, Rockport Street Railway, Nashua Street Railway, Gloucester Street Railway, Gloucester & Rockport, Gloucester, Essex & Beverly, Lynn & Boston, Beverly & Danvers, Salem & Wakefield.

Wakefield & Stoneham, Woburn & Reading, Mystic Valley, North Woburn Street Railway, West Roxbury & Roslindale, Needham & Boston, Norfolk Central, Norfolk Suburban, Boston, Milton & Brockton, Braintree Street Railway, Brockton Street Railway, Brockton & East Bridgewater, Brockton, Bridgewater & Taunton, Quincy & Boston, Taunton Street Railway, Dighton, Somerset & Swansea, Providence & Taunton, Globe Street Railway (Fall River), Newport & Fall River, Newport Street Railway, Newport Illuminating Company, and Hyde Park Electric Light Company. The above stock will soon be offered for public subscription at 105 for the preferred stock, each share of which will carry one-half share of common stock as a bonus. The stock has been underwritten. Of the remaining common stock, 10 per cent. goes to the underwriters. Of the balance, or 40 per cent., a portion has been used in obtaining a transfer of options that had already been secured by others for the purchase of some of the properties; a portion has been used as part payment for the companies purchased; a portion for the payment of the institutions and bankers who provided the money required prior to the underwriting, and for the bankers who effected the consolidation.

Special Correspondence.

NEW YORK NOTES

THE PEOPLE'S TELEPHONE COMPANY has decided to change its title so that it will not be confounded with the People's Telephone Corporation. On account of the similarity of names, considerable confusion resulted.

NEW CABLE TO CUBA.—It was announced a few days ago that interests allied with the Postal Telegraph Cable Company and the Commercial Cable Company had determined to go ahead with the projected cable to Cuba, the right to lay which the Commercial Cable Company was unsuccessful in its endeavor to secure from the United States government. It is stated that the capitalists who are ready to construct the new line are of the opinion that if the United States government is without power to consent to the laying of a new cable, it is also without power to prevent the construction of another line to the island; hence, they purpose going ahead with the work, feeling that they can assume any risk of future protection of their property. It is stated to be the purpose of the new organization to give to Cuba a modern long distance and local telephone service, as well as a telegraph system.

NEW ENGLAND NOTE.

THE SWETT & LEWIS COMPANY has been obliged to move to larger and more commodious quarters at 79 Franklin Street, Boston, Mass. It will continue the manufacture of static machines and X-ray supplies and will, in addition, carry in stock a full line of galvanic and faradic goods, light, cautery and epilation outfits, dry and wet cells, electrodes and everything pertaining to electro-therapeutic and X-ray work. The former address of the company was 11 Bromfield Street.

WESTERN NEW YORK NOTES.

THE NIAGARA FALLS POWER COMPANY, Niagara Falls, has awarded the contract for an extension of its transformer station. The addition will be 40 by 50 feet, and will be identical with the present style of architecture. Messrs. Braas Bros. & Lennon secured the contract.

THE INTERNATIONAL TRACTION COMPANY, at Niagara Falls, has appointed J. C. Rothery superintendent of the Niagara Falls Park & River Railway. He has also been appointed superintendent of the upper steel arch bridge, which is the property of the Traction Company.

JUSTICE HOOKER, at Niagara Falls, has granted an order accepting the offer made by Mr. Herbert P. Bissell of $25,000 for the repair of the Gorge road, provided the work is done at once, so that the line can be finished and put into operation by June 1, in order to prevent the charter from becoming void. Mr. Bissell also offered to bid at a public sale of the road, and all its properties, rights, franchises, etc., such sale to be subject to $1,000,000 mortgage and the contract expenses. The road will be sold at public auction in Lockport on May 22 or 23. Mr. Bissell represents the owners of 75 per cent. of the capital stock and the creditors holding 90 per cent. of all the claims included in the floating indebtedness.

INDIANA NOTES.

CHANGE OF NAME.—The Fort Wayne Electric Corporation has changed its name to that of the Fort Wayne Electric Works. The new owners announce that the manufacture of the "Wood" systems of arc, alternating current apparatus will be continued for the present.

NORTH MANCHESTER TROLLEY LINE.—The Town Council of North Manchester, on May 10, granted a franchise for the construction of a trolley line through the streets to Thompson Arnold and John Isenberger. The latter refused to state whom they represent in the matter, but it is intimated that a new interurban line is in project.

MR. BROWNELL GETS A RAILWAY FRANCHISE.—Mr. F. G. Brownell has secured a franchise for an electric line between Muncie and Hartford City. It is the intention of the promotor of the Muncie-Hartford line to have it constructed and in operation this season. He will then extend it through to Montpelier and Bluffton, passing through Eaton, Royerton and Shideler, all gas towns of note and enterprise.

PIPES DAMAGED BY ELECTRICITY.—Electrical Expert Brownell, of Dayton, Ohio, employed by the authorities of Logansport, reports much damage done to the gas and water mains from electrolysis. He reports the condition worse than any he has yet examined, though not nearly so much electricity is used to run the cars as is used at Indianapolis and other cities. According to his report a majority of the pipes have reached a porous condition, unfit to convey gas or water. In places nothing but a crust of rust is left, which is liable to give way at any time. He says it is one of the most peculiar cities he ever struck, owing to the advanced stage of electrolysis. His findings have caused much anxiety, and, here as elsewhere, stubborn litigation is likely to result to recover damages.

ELECTRIC RAILWAY STRIFE.—A bitter strife is being engendered over the proposed electric road to be built by the Indianapolis & Logansport Traction Company. Logansport citizens procured a franchise last summer through the district over which the Marott Company is now seeking a franchise. Notwithstanding they never pushed their project, they are now vigorously objecting to the granting of a franchise to the Marott Company. The people became impatient at the dog-in-the-manger method and called a mass meeting which passed resolutions authorizing a transfer of the franchise to the Marott Company. As the matter stands the Marott Company is in a fair way to complete its right of way through the disputed district. It owns the Logansport street car system and has all of the right of way to Indianapolis except the gap contended for. The citizens of Logansport, Frankfort and other cities tapped by the line are anxious for the completion of the road, while the merchants oppose it on the ground of trade being drawn to Indianapolis.

THE ANDERSON AND MUNCIE ELECTRIC RAILWAY.—The Henry syndicate having in charge the projected electric line between Anderson and Muncie to connect with a line leading to Indianapolis have begun the work of grading. The ties will be placed, the poles erected and the trolley wires strung this season, but the rails may not be lain until next spring. They state on account of the scarcity of rails they were unable to place an order to be delivered this season. In certain sections of the country through which this road is to be operated, opposition of a decided nature has arisen among the farmers and country town merchants. It is not known that this has had any effect upon the line or delay, but meetings have been held and expressions had for and against the road. The country merchants say their trade will all be taken to Muncie, Anderson and Indianapolis. In some cases the farmers have sounded a sympathetic note for the merchants, and it is possible that an organized movement will result. This opposition causes no alarm, however; the feeling is general among the more progressive people that this and many other lines will ultimately be built.

CHICAGO NOTES.

THE UNITED STATES EXPRESS COMPANY has ordered for its building, 87 to 89 East Washington Street, Chicago, a 30-kw Western Electric direct-connected generator. The plant will be used for running 400 16-cp incandescent lamps.

MR. EDWARD F. KIRKPATRICK, who is well known among the electrical fraternity, is now connected with the Chicago office of the Siemens & Halske Electric Company. He began in the electrical business as salesman for the Westinghouse Electric Company in 1886, in its Pittsburg office, and was later connected with the Cincinnati office. In 1892 he was transferred to the company's Chicago office, where he remained until late in 1897, when he accepted a position with the Fort Wayne Electric Corporation, remaining with that concern until its closed business. Mr. Kirkpatrick's 13 years' experience in the business has made him a salesman of marked ability, and his many friends in the West wish him success in his new position.

WISCONSIN NOTES.

ELECTRIC LIGHT AT ELROY, WIS.—The common council of Elroy, Wis., will secure plans for an electric light plant at once.

ELECTRIC LIGHT FOR COLUMBUS, WIS.—The common council of Columbus, Wis., has employed Mr. F. H. Ford, engineer, of Madison, Wis., to prepare plans for the electric light plant.

MERRILL'S NEW ELECTRIC LIGHT AND RAILWAY PLANT.—The new electric light and power plant at Merrill, Wis., is now completed, and Merril will again have lights and street car service, after having been without since last October, when the old plant burned down. The new plant cost $40,000.

J. K. TILLOTSON, a promoter, representing an eastern syndicate, has purchased the stock of the Oshkosh Gas Light Company. Mr. Tillotson is working on a plan to combine the Gas Company with the Oshkosh Electric Light & Power Company and the Citizen's Traction Company, and he already holds options on the two plants.

SALE OF THE WISCONSIN ELECTRIC COMPANY.—The stock of the Wisconsin Telephone Company has been sold to an eastern syndicate. The board of directors of the company met on May 17 and closed the deal, and the transfers were made and the directors and officers were elected. The new company has purchased over $600,000 of the $700,000 of stock held by the individual owners, paying $1.25 and 1 per cent. dividend added. The offer is still open for the balance of the stock. At the meeting Charles J. Glidden, of Lowell, Mass., the head of the syndicate, was present and explained the purpose of the new company. The old directors were all re-elected with the exception of B. K. Miller, Jr., and C. G. Stark, who retired to allow two of the new owners to become members of the board. The board is now composed of the following: C. J. Glidden, of Lowell; J. P. McKinstry, of Cleveland; Jesse Stone, of Watertown; Henry C. Payne, C. Ray, C. F. Pfister and F. G. Bigelow, of Milwaukee. The local directors each hold a qualifying share in order to allow

thers to act as the representative of the owners. The following officers were elected by the board of directors: President, Charles J. Glidden; vice-president, J. P. McKinstry; treasurer, Charles A. Grant, of Lowell, and secretary, George B. Perham, of Lowell; John D. McLeod will remain as manager and all of the present operating force will be retained. Mr. Glidden states that the policy of the company will be the same as was that of the old company, with the exception that it will be in a position to take a much broader scope than the old company and that all the plans of the old company, with many more, looking toward advancement of the service and the accommodation of customers, would be carried through.

ST. LOUIS NOTES.

TO MAKE TELEPHONE CONNECTIONS.—The Southern Electrical Supply Company was the lowest bidder on the contract for making connections of the wires of the city buildings with the Kinloch Telephone Company conduits. The bid was $17,500. The contract is to be finished in nine weeks.

UNION DEPOT RAILWAY MEETING.—The stockholders of the Union Depot Railway Company are to hold an important meeting Monday, June 19. The meeting has been called for the purpose of obtaining consent to the issuance by the company of bonds to the amount of $10,000,000. It is proposed to reserve a sufficient amount of these bonds to be applied hereafter to the payment or redemption of the existing bonded indebtedness of the company and that of any other railroad company or companies, the property of which the Union Depot Company owns or may hereafter acquire.

EXTENSION OF TRANSFERS.—It is estimated by street railroad men that in the neighborhood of 20,000,000 transfers were granted by the different street railways of this city last year. If the street railway consolidation bill at present pending in the Legislature is passed, and the prospects are good for its passing, it is proposed by the management of the National Southern Electric Syndicate to consolidate its eight companies under the name of the St. Louis Transfer Company, and to establish an even more extensive system of transfers than is now in effect. This system has fixed upon 47 transfer points on the various lines it controls.

PACIFIC COAST NOTES.

THE INDEPENDENT LIGHT & POWER COMPANY, San Francisco, with Claus Spreckels at its head, has proved that it means business by closing contracts with the representatives of the Westinghouse Electric & Manufacturing Company for underground cables and apparatus, aggregating two million dollars in cost. A year's time will be allowed for filling the contract. The main generating station will be located on the bay shore, in the southern part of the city, near the Spreckels sugar refinery. Current will be generated by two-phase alternators and transmitted to the several sub-stations in three-phases and finally distributed as two-phase current. The underground distribution system will be up to the latest practice, the material costing $500,000. Mr. A. M. Hunt, the Independent Company's consulting electrical engineer, recently returned from the East, where he thoroughly investigated the methods of distribution in use in the principal cities. San Francisco now has competition in gas-lighting, and with the capital and skill behind the new company it will be little more than a year until there will be a formidable rival in the electric lighting field.

TEXAS AND MEXICO NOTES.

A NEW TELEPHONE EXCHANGE is being established at San Marcos, Texas, by Mr. R. L. Durrett.

A NEW ELECTRIC LIGHT PLANT is to be established at Jacksboro, Texas, by Mr. J. E. Campbell, manager of the Bowie Light Company.

TELEPHONE EXCHANGE FOR SMITHVILLE.—Messrs. L. Hill & Son, of Pittsburg, Texas, have taken steps looking to the establishment of a new telephone exchange at Smithville, Texas.

NEW STREET RAILWAY FOR FORT WORTH.—Judge J. E. Martin and other capitalists of Fort Worth, Texas, have organized a company to construct and operate an electric street railway through the eastern part of that city.

TELEPHONE WAR CONCLUDED.—The spirited fight between the Southwestern Telegraph & Telephone Company and the Independent Telephone Company, of Waco, Texas, which has been going on for some time, has been terminated.

MR. S. W. SLAYDEN, of Waco, Texas, who recently purchased the Topo Chico street railway system in Monterey, Mexico, from Major Jules Randle, has just completed a careful inspection of the property. He purposes to extend the line and to make many important improvements.

GUADALAJARA'S STREET RAILWAYS.—The extensive street railway system of Guadalajara, Mexico, is about to be sold to an European syndicate of capitalists. This syndicate secured an option on the property a few days ago and it holds good for two months. Guadalajara is the second city in size in Mexico, and it is said that there is more wealth centered there than in any other city in that country. If the syndicate consummates the deal now pending the entire railway system will be equipped with electric power.

THE SOUTHWESTERN TELEGRAPH & TELEPHONE COMPANY is constructing a long distance telephone line from Longview, Texas, to Houston. This company recently made some important changes in the conduct of its business in Texas. Superintendent E. K. Baker, of the Austin office, has been promoted to be general manager of the southern district of that state; Mr. J. A. Farnsworth, superintendent of the Dallas office, has been promoted to be general manager of the northern district. Mr. A. E. Jeavens, of Houston, has been appointed to be general superintendent of the southern district, and Mr. Tom Milburn, of Dallas, to be general superintendent of the Northern district of Texas.

SALE OF GALVESTON STREET RAILWAYS.—Since the order for the foreclosure of the Galveston City Street Railway and the Gulf City Street Railway systems was issued by the Federal court, the city council of Galveston, Texas, has passed an ordinance authorizing the purchaser of these two lines to consolidate the same. The ordinance also grants the purchaser a franchise to extend the consolidated system over a number of other streets of that city. The franchise is for a period of 25 years, at the expiration of which time the city reserves the right to purchase the lines. The ordinance further provides that out of the money derived from the sale of these lines the city shall be paid an amount, aggregating $50,000, due on an old contract, and for taxes, etc. The sale of the two systems is to take place Sept. 5.

CANADIAN NOTES.

ELECTRICALLY PROPELLED CANAL BOAT.—At a recent meeting of the Amalgamated Hudson Canal Association, it was decided to offer a prize for a practical canal boat operated by electric power. Mr. H. L. Welsh, of Comansville, Quebec, has come forward with such a boat and hopes to obtain the prize.

THE BELL TELEPHONE COMPANY will build a new copper metallic line between Ottawa and Arnprior, Ont., and work will be commenced at once. The company is establishing a number of pay stations in Montreal on the nickel-in-the-slot principle. The instruments will be placed in drug stores, but the system will be distinct from the ordinary telephone in the store.

THE HAMILTON STREET RAILWAY SALE.—In connection with the recent attempt of the Cataract Power Company to obtain control of the Hamilton (Ont.) Electric Street Railway, Mr. John Patterson, secretary of the Cataract Company, secured, it is said, an option on about $9000 worth of stock owned by Mr. E. B. Charlton. Mr. Charlton subsequently refused to sell, and a writ has been issued against him, at the instance of Mr. Patterson, to compel the specific performance of the alleged agreement.

THE FISCHER EQUIPMENT COMPANY, of Chicago, is represented in Canada by the Motor Carriage Company, of Ontario, in which large shareholders of the Canadian General Electric Company are interested. The company proposes to manufacture under the Woods' patent in Peterboro, Ont., at the works of the Canadian General Electric Company, and its charter covers all lines of autocar development. Canadian capitalists, interested in electrical works, are also organizing an American company for $3,000,000 in New Jersey, and will have factories in Chicago and in the east for the purpose of exploiting the Woods' electric patents.

STREET CAR FENDERS.—Mr. D. McDonald, superintendent of the Montreal Electric Street Railway, has recently been on an extended trip to several American cities with the object of studying their car systems. Regarding the occurrence of accidents, he had found it difficult to obtain any positive figure on the subject from the various railroad officials. He had found every kind of fender in the cities he had visited. Every fender imaginable had been given a fair trial in the United States, and it had invariably been found that there are none positively reliable. Mr. McDonald will make a report to the street railway management regarding the various good points in the fenders he had inspected during his visit in the United States.

THE CANADIAN MOTOR SYNDICATE, pioneers of the movement in Canada, has within the past month established works in Toronto, Ont., and, it is said, the company is already crowded with orders for electric motets, delivery vans and carriages. The motet seems to have caught the popular fancy. Several improvements, notably in frame and wheels, have lately been introduced in its construction, making it stronger and provision has been made for the same frame to carry either a 30-mile or 50-mile equipment—the boxes of cells being readily removable from the side. With this construction it is claimed that it will be possible by use of duplicate battery to keep a motet out constantly, making a total of 100 miles per day—thus doing the work of about five horses on light loads, such as butchers and grocers carry.

ELECTRICAL DEVELOPMENT IN CHINA.—Kang-Yu-Wei, the exile Chinese reformer, who is at present visiting the Canadian capital, appears to be greatly interested in electrical development. In company with street railway officials he paid a visit to the power house of the company at the Chaudiere Falls, at Ottawa. The Oriental politician was accompanied on his tour of inspection by his two native secretaries, who made extensive notes of the information gained, and he manifested great interest in the various details and workings of the machinery, dynamos, etc. Kang-Yu-Wei is desirous of promoting electric interests in his native land, and on his return from the present exile, will make use of the pointers he has secured on his travels. Outside the treaty ports, Canton is the only Chinese city that has an electric plant, and this one is but an imperfect affair. Kang-Yu-Wei secured from Messrs. Ahearn & Soper, of Ottawa, estimates on the probable cost of an electric lighting plant for Canton. He is very much impressed with Canadian railways, both steam and electric, and has intimated that, if he ever attains to power again in China, it is his purpose to promote a railway policy along the same lines.

THE WEST KOOTENAY POWER & LIGHT COMPANY, of Rossland, B. C., has met with such success in its power transmission project that it has found it necessary to increase its plant to double the present capacity. About a year ago this company commenced supplying current to its customers at Rossland and Trail, a distance of nearly 40 miles from the power house, which is located at Bonnington Falls, on the Kootenay River, and to-day has more orders for power than it can supply. The present generating plant consists of two 1000-hp, three-phase rotary field dynamos and the company has just placed an order for a 2000-hp generator of the same type. The Canadian General Electric Company is also supplying a complete equipment of marble panel switchboards,

and 3000-kw capacity in high potential step-up and step-down transformers. When this additional installation is completed the West Kootenay Company will have one of the largest power plants in the Dominion, and the distance of transmission is the greatest now in operation in Canada.

General News.

THE TELEGRAPH AND TELEPHONE.

DUBUQUE, IOWA.—The Standard Telephone Company has been granted a franchise in this place.

SALEM, N. Y.—The Salem Telephone Company has been incorporated, with a capital stock of $100,000, by Henry A. Hale, Joseph Parsons and George W. Pitman.

ST. MARY'S, OHIO.—A telephone exchange is to be established in this place by the St. Mary's Telephone Company, just incorporated, with a capital stock of $20,000.

AVON, ILL.—The North Fulton Telephone Company has been organized in this place, with a capital stock of $1500, by A. E. Hatch, F. E. Woods and H. F. Townsend.

MONTEVIDEO, MINN.—The Citizens' Telephone Company, of this place, has just been organized, with a capital stock of $10,000. Mr. R. D. Zimbeck is president, and J. O. Houghland, secretary.

WAPAKONETA, OHIO.—The independent telephone system of this city has been purchased by L. M. Blume, president of the First National Bank of Wapakoneta. The consideration was $10,000.

LE SUEUR, MINN.—The Le Sueur Telephone Company, with a capital stock of $10,000 has filed articles of incorporation. The incorporators are F. H. Weis, James McKasey and M. W. H. Grimes.

PULASKI CITY, VA.—The Wythe Telephone Exchange has been organized in this place, with a capital stock of $5000, by D. D. Hull, Jr., B. F. Garnett, B. Laughon, George M. Holstein, all of Pulaski.

CHICAGO, ILL.—The Standard Telephone Construction Company is the name of a new concern organized in this city, with a capital stock of $10,000, by Messrs. W. T. Rowell, John Syirlen and J. B. Osmun.

JACKSON, MICH.—The Peninsular Telephone Company has been organized, with a capital stock of $20,000. The promoters are V. B. Osborn, W. C. Osborn, Charlotte; C. K. Perrine and E. M. Perrine, Jackson.

ATKINSON, ILL.—Messrs. W. D. Colby, W. H. Cosner and Isaac Pyle are the incorporators of the Henry County Telephone Company, with headquarters in this place. The capital stock of the company is $2500.

AMBOY, MINN.—The Sterling-Amboy Telephone Company, with a capital stock of $10,000, has been incorporated by L. W. Wells, Willoughby Wells, C. H. Brace and William Ellis, Sterling; and C. J. Louer, J. E. Merrill and Chas. Thompson, Amboy.

WILMINGTON, DEL.—The Diamond State Telephone Company has decided to extend its lines to Wilmington. Efforts will be made to enter into a contract with the Delmarvia Telephone Company, of this city, so that the latter's system may be used.

BALTIMORE, MD.—The Baltimore Telephone Construction Company has been organized here, with a capital stock of $10,000. The incorporators of the new concern are William F. Martin, Frank W. Wilkinson, Charles F. Taylor, Harry Rogers and Jesse Slugluff.

CHICAGO, ILL.—A new telephone company has been organized in this city under the name of the Independent Telephone Company. Its capital stock is $2500, and among the incorporators are the following named: Blanch Hovey, M. G. Musgrave and John R. Lyman.

ELLICOTT CITY, MD.—The Citizens' Telephone Company, of Howard County, has been organized in this place by the following incorporators: Louis T. Clark, William Davis, Jr., J. S. T. Waters, Frederick H. Bailliere and James H. Gaither. The capital stock of the company is $15,000.

BEAVER SPRINGS, PA.—The Spring Telephone Company has just organized here, with a capital stock of $2000, to build lines in Union, Snyder, Mifflin and Juniata Counties. The incorporators are J. D. Haines, J. Romig, Clymer Romig, H. H. Spahn, J. B. Spangler, all of Beaver Falls.

PALMYRA, N. Y.—The Fluvanna Telephone & Telegraph Company has been organized in this place, with a capital stock of $5000. The incorporators of the new company are C. E. Jones, Carysbrook; T. E. Cowherd, Columbia; William Sclater, L. O. Haden, J. O. Shepherd, all of Palmyra, and others.

KANSAS CITY, MO.—The Missouri & Kansas Telephone Company will put into effect about July 1 a new schedule. The new time basis on which all charges will be computed will be three minutes, and all persons may then converse for three minutes or less and pay only three-fifths of the present rate.

SAN FRANCISCO, CAL.—The Western Automatic Telephone Exchange is the name of a new concern just organized here to do a general telephone business. The capital stock is $25,000, and the incorporators are Scott Calhoun, Andrew White, John H. Mitteo, A. C. Aiken, all of San Francisco; Archie Borland, Oakland.

MT. STERLING, OHIO.—The Mt. Sterling Telephone & Electric Company has been incorporated to build telephone lines in Madison, Pickaway, Franklin and Fayette Counties. The capital stock is $6000, and the incorporators are Clay Johnson, O. W. Loofborrow, I. S. Henkle, W. R. Richards and J. A. Miller, all of Mt. Sterling.

GALLIPOLIS, OHIO.—The Gallipolis Telephone Company has been organized to build telephone lines in Meigs, Lawrence, Gallia and Vinton Counties. The capital stock of the company is $30,000. The incorporators are A. L. Bigelow, Thomas E. Bradbury, William B. Shober, W. W. Morrison and C. N. Henking, all of Gallipolis.

TOPEKA, KAN.—The Topeka City Council has granted a franchise to the Phoenix Telephone Company to operate a telephone system in this city. The company will give the city 3 per cent. of the gross earnings for the first ten years and 10 per cent. after that. The Missouri & Kansas Telephone Company, it is stated, tried to prevent the granting of a franchise but failed.

HARTFORD, CONN.—A company has been organized in New Britain for the purpose of building a telephone line between that place and Winsted. The line will pass through Farmington, Unionville, Collinsville and New Hartford and will connect the exchanges in New Britain and Winsted. The name of the new company is the Farmington Valley Telephone Company and its capital stock is $3500.

JERSEY CITY, N. J.—Mayor Hoos, of this city, has vetoed the ordinance granting to the Hudson Telephone Company permission to lay conduits for telephone wires through the principal streets of lower Jersey City and the Heights. The mayor says that the company should pay a round sum of money yearly, or a certain percentage of the earnings into the city's treasury and furnish every department of the city government with an instrument free of charge. He suggests that a new ordinance be drafted incorporating the provisions of the old ordinance and also certain concessions offered by the company.

ELECTRIC LIGHT AND POWER.

BELGRADE, MINN.—Bids will be received up to June 3 for the purchase of $6000 water and electric light bonds.

SCHOOLCRAFT, MICH.—The council has granted a franchise to an electric light company, which will install a plant in this place.

WATERVILLE, N. Y.—An election was held in this place recently to vote on the question of installing an electric light plant here. The proposition was carried.

PERTH AMBOY, N. J.—The plant of the Raritan Electric Light & Power Company has been sold to the People's Electric Light & Power Company, of Newark.

SPRINGFIELD, ILL.—The Peoria Lighting & Power Company has been incorporated here, with a capital stock of $50,000, by Lewis W. May, Godfrey G. Luthy and Ferd. Luthy.

SANTA ROSA, CAL.—The Common Council has accepted the bid of the Clear Lake Electric Light & Power Company for a franchise in this city. The company will pay the city 3 per cent. of its gross receipts each year.

GRANVILLE, N. Y.—The Granville Electric Light & Power Company has been incorporated, with a capital stock of $80,000. The directors are Adolph Reimer, Dover Plains; Eugene R. Norton and Joseph B. McCormick, Granville.

PHILADELPHIA, PA.—The West End Trust Company's Building will have a very complete electric light plant. The Ball Engine Company, Erie, Pa., will furnish the engines, which are to be direct-connected to Westinghouse generators.

HARTFORD, CONN.—The directors of the Hartford Electric Light Company have authorized an increase of capital stock by $200,000. This will be alloted at par to the stockholders in the ratio of two new shares for each five of their present holdings.

NEW BRUNSWICK, N. J.—The purchase of the plant of the Edison Electric Illuminating Company of this place by a syndicate has been consummated; $105 per share was paid. The new management will assume the bonded indebtedness of $50,000 at 6 per cent.

HAZLETON, PA.—The Edison Illuminating Company and the West End Electric Light Company, of this city, and the Edison Electric Light Company, of Freeland, have been consolidated and will hereafter constitute one company. The promoters of the combined company are E. C. Jones & Co., of New York. The capitalization of the companies concerned is $93,000.

THE ELECTRIC RAILWAY.

PATERSON, N. J.—It is stated that there is a movement on foot for the consolidation of all the trolley lines operating in and about Paterson.

TOLEDO, OHIO.—The franchise for the Shore Line Railway will be sold to the highest bidder, the City Council having refused Mayor Jones' plan for municipal ownership.

CLEVELAND, OHIO.—The Cleveland & Eastern Railway Company is constructing a line to Chardon and Gates Mills. A power house at Gates Mills is nearly completed and the line will be in operation by Aug. 1.

WHEELING, W. VA.—This is the sixth week of the strike of the street railway employees. The company runs its cars upon a regular schedule, but ceases operation at 10 o'clock at night. The cars are not patronized.

NEWARK, OHIO.—The Newark & Granville Electric Street Railway, which includes the Newark lines, will be sold by order of the court. The Equitable Trust Company, of New York, has, it is stated, offered $147,000 for the property.

CALUMET, MICH.—The Calumet & Hecla Mining Company has granted a franchise to John D. Cuddihy and Edward Ryan, of this city, to build an electric street railway through their property and connecting the cities of Laurium and Red Jacket.

PITTSBURG, PA.—The Westinghouse Electric & Manufacturing Company has received an order to equip the West Jersey Seashore electric railway, which will run between Philadelphia and Atlantic City. It is expected that the road will be in full operation before the summer rush begins.

KNIGHTSTOWN, IND.—The council has granted a franchise to the Indianapolis, Greenfie'd & Knightstown Rapid Transit Company, also to the New

Castle & Knightstown Electric Company. It is the intention of these concerns to build an electric railway from Indianapolis to New Castle through this place.

CHICAGO, ILL.—The Chicago Union Traction Company will be the name of the new corporation to be formed by the syndicate which has purchased the holdings of Mr. Charles T. Yerkes. The new company will be organized under the laws of Illinois, and will have a capital stock of $32,000,000, of which $12,000,000 will be preferred and $20,000,000 common.

SEATTLE, WASH.—The consolidation of six of the eight street railway companies in this city has been effected by C. A. Stone and L. J. Webster, who represent Boston capitalists. A new company will be incorporated either in New Jersey or in New York, with a capital stock of $5,000,000. The company will ask for a 40-year franchise from the city.

ELMIRA, N. Y.—The Elmira & Corning Railway Company has been incorporated, with a capital stock of $200,000, to construct and operate a street surface electric road between the two cities named. The distance is 18 miles. The directors are: Hiram B. Rhymer, John M. Diven, Clinton M. Paul, Wallace W. Seeley, Charles A. Allen and Edwin S. Brown, of Elmira; Peter Marshall, of Horseheads, and James L. Rhymer, of Philadelphia, and John R. Miner, of Big Flats.

ALBANY, N. Y.—The preliminary survey for the Saratoga and Schenectady Suburban & Electric Railway has been completed and the work preparatory to letting the contract for construction is in progress. Ninety per cent. of the rights of way have been secured and it is estimated that the cost of construction and equipment will be about $25,000 per mile. The road will be nearly 24 miles long and will run through Schenectady, Scotia, Ballston Spa, thence through private right of way to Saratoga Springs.

JEFFERSON, OHIO.—Application for the incorporation of the Burton, Jefferson & Andover Electric Railway has been made. The incorporators are Eugene Rawdon, Windsor; Clayton Reeves, Orwell; W. H. Dodge, New Lyme, A. H. Lindsley, Cherry Valley; E. H. Green and J. L. Osborne, Andover; Cliff Meigs, Lenox, and Hon. E. L. Lamson, Jefferson. The capital stock of the company is $10,000. The project is a continuation of the Cleveland-Burton line, and is designed to reach Conneaut, Ashtabula and Geneva eventually.

LEXINGTON, KY.—The Lexington Railway Company has been purchased by Mr. R. Lancaster Williams, representing Richmond, Va., and Baltimore capital. This property consists of the Belt Electric Line Company, which operates the electric railway, and the Central Electric Company, which operates the electric light plant, the Hercules Ice Company and the Passenger & Belt Railway Company. The terms have not been made public, but it is estimated that the price was near $750,000. Mr. R. T. Gunn has been appointed superintendent of the new concern.

HAMPTON, VA.—A competing electric line between this city and Old Point Comfort has appeared. Ties and rails have been delivered, and the right of way between the intervening cities has been secured. The old company, which is the Newport News & Old Point Railway & Electric Company, is using all means in its power to restrain the new company from laying track. It has secured a temporary injunction preventing it from paralleling tracks in the county. A series of counter injunctions have been granted on both sides, and the outcome of the question is uncertain. Mr. Livsey, auditor of the Shipbuiding & Dry Dock Company, Newport News, together with the president of the Old Dominion Land Company, is interested in the new road.

LEGAL NOTES.

PENBERTHY INJECTORS.—In the suit instituted by the Penberthy Injector Company to restrain the Lee Injector Manufacturing Company, successor to the Lee-Penberthy Manufacturing Company, Detroit, Mich., from using the name "Penberthy" in its corporate name and on the "Lee" injector the Supreme Court of Mhichigan has decided for the complainant. The Lee Injector Manufacturing Company announces that it has fully complied with this decision. In the future its corporate name will be Lee Injector Manufacturing Company. This decision and change of name will not change the policy of the company's future business nor interfere with the manufacture or sale of its Lee injector or other goods manufactured by it.

CANADIAN TELEGRAPH SUIT.—Much interest is taken in Canada and at Montreal in particular in an action taken in the high court in Toronto, by two Boston brokers, to annul the lease of the Montreal Telegraph Company's lines by the Great Northwestern Company. The lease was granted in 1881, and was for a period of 97 years, the rental being $165,000. The plaintiffs in the case are Hugh M. Morrow, and William A. Clark, jr., who, as holders of 750 shares of the Great Northwestern, claim that the company had no power to enter into such an agreement, nor had the Western Union Telegraph Company power to guarantee the rental, as they really did. The plaintiffs say the Great Northwestern is in reality the Western Union, and that Mr. H. P. Dwight, who holds most of the Great Northwestern shares and is president of the company, is really an agent of the Western Union. They further say that the agreement in dispute is "an attempt by a foreign corporation, through possession of the majority stock of the Great Northwestern, to exercise and use the statutory powers and franchises of that company, solely in their own interests, an attempted misuse and abuse of statutory powers and franchises." In their statement of defense the Great Northwestern insists upon the validity of the agreement, and the power of the Western Union to guarantee the rental thereunder. They say the agreement was made in the interest of all parties, and has for more than 18 years been faithfully carried out. The holder of the shares now alleged to be held by the plaintiffs at the time of the entering into of the agreement, the defense say, was Erastus Wiman, who was one of the most active shareholders in procuring the assent of the companies to the agreement. The shares were used to vote upon, and by them the agreement was entered into. The Great Northwestern submits that such shares cannot now be used for the purpose of invalidating the same agreement. The other parties to the defense, the Montreal and Western Union Companies, and M. Dwight—should the court consider him a co-defendant—set up the same pleas, with one or two additions.

PERSONAL NOTES.

MR. PAUL JOHN KRUESI, son of the late John Kruesi, Mr. Edison's long-time associate, has made his debut in electrics by becoming associated with the General Incandescent Arc Light Company in this city.

MR. FRANK G. BOLLES has assumed the management of the advertising department of the Bullock Electric Manufacturing Company, Cincinnati. Mr. Bolles, who was formerly a member of the staff of THE ELECTRICAL WORLD, has made an enviable reputation in this branch of business, which he has made a special study.

Trade and Industrial Notes.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, of Madison, Wis., reports recent exports to St. Petersburg, Russia, of 30 dynamos and motors, averaging 10-hp each.

THE GREAT NORTHERN HOTEL, Chicago, is installing 10 Western Electric motors, to operate the ventilating apparatus, laundry machinery, dish-washing apparatus, machine shop and to drive the organ.

THE AMERICAN CHEMICAL & SPIRITS COMPANY, of Evansville, Ind., has recently installed an electric plant. The Ball Engine Company, Erie, Pa., furnished the engine, which is direct connected to a General Electric generator.

GENERAL INCANDESCENT ARC LIGHT COMPANY has issued a neat pamphlet in red cover, summarizing its various sub-companies and the different numerous specialties that it is now manufacturing and marketing with such succcess.

THE AMERICAN ELECTRICAL & MAINTENANCE COMPANY, of New York City, has been incorporated, with a capital stock of $50,000. The directors for the first year are Alfred K. Warren, F. James Reilly and William F. Reilly, New York City.

THE PRATT & LETCHWORTH COMPANY, Buffalo, has issued a pamphlet on the subject of American developments and processes in the production of hematite malleable iron and steel castings. The subject is illustrated in a rather catchy manner.

THE JANDUS ELECTRIC COMPANY, Cleveland, Ohio, is installing 243 Jandus arc lamps of the 25-inch type at the Boston Navy Yard. This is the fourth order received by this company for lamps of this type for installation in Atlantic coast navy yards.

THE MANHOLE COVER shown in the exhibit of the American Vitrified Conduit Company at the Electrical Exhibition, in Madison Square Garden, referred to in Exhibition Notes last week, is made by the Greger Manufacturing Company, of Philadelphia, and not by the McGregor Company, as stated.

MR. GEORGE WILLIAM HOFFMAN, 295 East Washington Street, Indianapolis, Ind., reports that he has just made a large shipment of U. S. metal polish to Canada, and that his foreign trade continues to increase. He states that there is no playing while the demand is so great for this polish.

LA CAPITAL TRAMWAY COMPANY, of Buenos Ayres, Argentina, has placed an order with the Berlin Iron Bridge Company, of East Berlin, Conn., for a steel water tower, supporting a tank having a capacity of 7000 gallons. This is the fifth order the Berlin Iron Bridge Company has received from this company.

THE MERRITT ELECTRIC AIR BRAKE COMPANY, of Jersey City, N. J., has been organized under the laws of West Virginia, to manufacture and deal in electric air brakes. The capital stock is $1,000,000 and the incorporators are David Jankower, of New York City; William Earl Hidden, William R. Weeks and Oscar C. Kinye, all of Newark, N. J.

MESSRS. F. E. BAILEY & CO., Reading, Pa., have the contract for the building of an electric light and water power plant for the Roanoke & Navigation Water Power Company, at Weldon, N. C. This plant will be used for the lighting of Weldon and the yards of the Seaboard Air Line and the Atlantic Coast Line, also the mills owned by these companies.

MESSRS. KENDRICK & DAVIS, Lebanon, N. H., have just issued a catalogue of the Porter standard motor. Messrs. Kendrick & Davis are successors to the Porter Standard Motor Company. They manufacture motors, dynamos and fans and deal in battery supplies. The catalogue is illustrated with various sizes of Porter motors, which have been on the market for several years.

MR. GERALD W. HUNT, formerly of the Hart & Hegeman Company, notifies us that he has severed his connection with that concern and is about to put a new line of goods on the market. The first of these specialties will be a two-button push switch to which the attention of the trade is called this week and which is being introduced by the Hart Manufacturing Company, of Hartford, Conn.

THE AMERICAN WOVEN WIRE BRUSH COMPANY, of Peabody, Mass., reports an increase in its business. Shipments of its goods are being made to all parts of the country, and inquiries from Cuba and from Canada show that its goods are worthy of consideration. The company is in a position to fill promptly any orders, large or small, for any description or size of brush and will be pleased to receive communications from jobbers and users of goods in its line.

WHITNEY INSTRUMENTS.—That the Whitney Electrical Instrument Company is meeting the requirements of the trade in the line of electrical test-

ing instruments is shown by its latest catalogue, which is a most complete list of electrical testing instruments. The Whitney instrument has established a reputation as a medium-priced, high grade instrument. The Electric Appliance Company, Chicago, the general western agent, is prepared to supply new catalogues promptly on application.

THE GEORGE C. TOWLE MANUFACTURING COMPANY, Lancaster, Pa., some months ago moved its factory and offices into a larger building. Its new factory is now running to its full capacity, and has orders for weeks ahead. The company has just received quite a large order from London for desk fans, which it is now rushing to completion. Its new ceiling fan is said to be a success, and it cannot supply the demand fast enough. Its descriptive catalogue No. 5 of fan motors has just been issued and is very complete, illustrating all the company's different styles of fans.

MANUFACTURERS OF ELECTRIC AUTOMOBILES.—The Mica Insulator Company, of 218 Water Street, New York City, and 117 Lake Street, Chicago, is especially equipped for the manufacture of commutator rings and segments for motors employed in automobile work. Its "Empire" and "M. I. C." compound, cloths and papers are being used quite extensively by manufacturers of motors for electric vehicles. The company offers to send to any automobile company a set of rings and segments for trial, free, together with samples of their "Micanite" and "Empire" insulating cloth and paper.

PERKINS SLATE BASE KNIFE SWITCHES.—A new line of knife switches has just been put on the market by the Perkins Electric Switch Manufacturing Company, of Hartford, Conn. These switches are made in three sizes, 25, 35 and 50-ampere. There are nine kinds of each size giving a full line of 27 switches. Single pole, double pole, three point, double and single break, also fused. All of the working parts of the switch are made of copper, and the carrying capacity is fully 50 per cent. above the rating of the switch. The distance between posts and length of blade is up to the requirements of the fire insurance companies.

THE GRAHAM EQUIPMENT COMPANY, 521 Exchange Building, Boston, Mass., has received an order for 135 automobile trucks from the National Transportation Company, of Boston, to be used under the busses of the various lines this company is establishing in the suburbs of Boston. The trucks will be built with steel frames and equipped with Graham spring suspension and equalized brakes. By the use of this spring suspension, it will be possible to do away with rubber tires and yet permit the vehicles to run over the city pavements at a high rate of speed without jar or inconvenience to the passengers or damage to the mechanism.

STEEL RAILS FROM ENGLAND.—The Boston Elevated Railroad has just received a consignment of 300 tons of steel guard rails from London, to be used on its new structure. General Bancroft, the general manager of the company, said that he had made every effort to place the order with some American firm, but that when he went into the market he found that competition in these particular rails (which are used as curves and weigh about 109 pounds to the yard) had been eliminated, and that he would have to pay the price established if he was to use American-made rails. This price he considered exorbitant and he invited quotations from English makers. As a result the contract was given to Dick, Kerr & Company, of London, at a price considerably under that made by the domestic mills and which admits of the rails being landed here duty paid at a saving of perhaps 33 per cent. over the price asked by the consolidated steel concerns here.

THE CASE MANUFACTURING COMPANY, Columbus, Ohio, has recently placed several electric traveling cranes in operation, among which may be mentioned the following: The Burgess Steel & Iron Works, Portsmouth, Ohio, one 60-ton; American Steel Foundry Company, St. Louis, Mo., one 30-ton; the Alcania Company, Pittsburg, Pa., one 15-ton. The company has also put in operation hand-power cranes as follows: Sanderson & Porter, New York City, one 10-ton; Wheeling & Elm Grove Railway, Wheeling, W. Va., one 6-ton; Robinson & Co., Richmond, Ind., one 3000-lb. It has also just shipped to the Cumberland Steel & Tin Plate Company, Cumberland, Md., one 25-ton electric traveling crane, and to the U. Baird Machinery Company, Pittsburg, Pa., two small cranes. The company has orders for electric traveling cranes as follows: Moran Bros. Company, Seattle, Wash., on 25-ton; Long & Alstatter Company, Hamilton, Ohio, two 25-ton; Ferrell Foundry & Machine Company, Ansonia, Conn., one 15-ton; Erie City Iron Works, Erie, Pa., one 25-ton; L. Schreiber Sons' Company, Cincinnati, Ohio, one 10-ton; Missouri Railroad Company, St. Louis, Mo., two 75-ton; Canton Roll & Machine Company, Canton, Ohio, one 15-ton; Columbus Electric Company, Columbus, Ohio, one 10-ton hand-power crane; the Crane Company, Chicago, Ill., one 4000-lb. electric crane, and the Barstow Stove Company, Providence, R. I., one 3000-lb. jib crane.

THE ENGINEERING AND CONSTRUCTION DEPARTMENTS, of the Chicago Edison Company, Chicago, report a good business in their wiring and isolated plant work. Among the new contracts now in progress and recently awarded may be mentioned the following: The Oliver Hotel, South Bend, Ind., wiring for 1800 16-cp lamps in iron-armored conduit; also a complete annunciator and telephone system, a marble switchboard, instruments and connections for two 40-kw and two 60-kw General Electric dynamos direct-connected to Ball engines; the Massachusetts Building, Baltimore, Md., one 60-kw General Electric dynamo direct-connected to a Harrisburg Ideal engine; also wiring for about 1000 16-cp lights in iron-armored conduit; at the Grand Central Depot, Chicago, two 75-kw General Electric dynamos, direct-connected to a 250-hp Ames engine; also one 45-kw belted General Electric dynamo, and a large new marble switchboard, with connections for the complete plant of 8 dynamos; Boys' Training School at Glenwood, Ill., wiring for 14 arc lamps and 500 incandescents distributed among the various buildings, the wiring to be connected to one 45-kw General Electric dynamo driven by an 85-hp Ideal engine. The contract has just been awarded for the plant of the State Normal School, DeKalb, Ill., where the company is installing one 40-kw direct-connected engine and dynamo unit, marble switchboard and instruments and the wiring for about 1100 incandescent lamps. Several buildings are also being wired for central station service from the Chicago Edison Company's central station. The same company is also wiring about 2000 incandescent lamps in the same to be connected to its central station service.

THE FERRACUTE MACHINE COMPANY.—During the past three years there has been a great increase in the manufacture of motors and dynamos and other electrical goods, and as a large amount of sheet-metal work is required in connection with these machines, naturally special machinery has been designed for producing the parts rapidly and accurately. Foremost among the machinery manufacturers in this line are the Ferracute Machine Company, of Bridgeton, N. J., which makes a full line of presses and dies and other sheet-metal machinery. This company has followed closely the needs of the dynamo manufacturers and has gotten up patterns for the special presses to suit their work. It has built some very large double crank presses, some of them weighing 26,000 pounds, and which are capable of cutting 100-inch disk sections; also smaller presses for cutting complete circles in either thick or thin metals. It also builds special indexing machines for cutting the notches in the disks rapidly and accurately, and has also paid considerable attention to the matter of heavy presses for cutting out various parts of instruments and for drawing shells and cups, such as are used for electrical bells, push buttons, etc. In the smaller motors and dynamos some of the frames can be made partly of sheet-metal. These can be formed up from thick metal either hot or cold. The Ferracute Machine Company has just issued a new catalogue describing 300 different sizes and kinds of presses and a number of the pages of this catalogue are devoted to machinery for electrical purposes. It is now building five large double crank presses, two of which are being shipped to the General Electric Company and the other three to the Westinghouse Electric & Manufacturing Company. A number of these have recently been sent to the various European factories. The company is very busy in its works. It now has orders from England, France, Germany, India, New Zealand, Australia and Mexico, and its foreign trade is constantly increasing.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 16, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

624,487. PRINTING TELEGRAPH; H. Himrod, Chicago, Ill. App. filed March 25, 1898. A system of telegraphy comprising a keyboard transmitter acting to produce permutations successively in a number of sets of pole-changers having an intermittent rotary motion, a sunflower and trailer for distributing the sets of impulses successively to the line and having a continuous rotary motion so as to distribute the intermittently-produced permutations continuously and with approximate uniformity to the line, a single line-wire receiving the character impulses, a double relay controlling two local circuits, a distributer having two sets of distributing-contacts and also carrying a circuit-controller controlling the printing-circuits, and a circuit-controller controlling the circuits to the selector-restoring magnets, a selector made in two parts in which the character permutations are alternately established by the distributer, and in which the printing and restoring circuits are operated for one division of the selector, while the permutations are being established in the other divisions of the selector, and a printing mechanism comprising a series of selecting-magnets, one for each type, and a printing-magnet which moves the types selected, the printer-selecting magnets being located in branches from both divisions of the selector and the printing-magnet being located in a common return to said branches. (Issued May 9.)

624,904. ELECTRICAL SWITCH APPARATUS; W. F. Bossert, Utica, N. Y. App. filed Oct. 15, 1898. In electrical switch apparatus comprising crossing bars representing main and branch conductors, electrical connection is usually established between such as are intended to be connected, by interposed blocks or bridge pieces. This invention is designed to dispense with such interposing blocks and thereby eliminate the resistance afforded by the joints which they entail, and it is proposed in lieu of the spacing blocks to bend or offset the bar itself and make direct connection between the bars at the points of crossing.

624,914. TROLLEY; E. Duty, Jr., Cleveland, Ohio. App. filed Feb. 10, 1898. The axle of the wheel is extended in both directions, the extension portions being surrounded by a sleeve of incandescing material; a conducting rod extends along the upper side of the sleeve and is connected with the hub of the wheel. This rod is so located that when the trolley pole is in its most vertical position, as it is at railroad crossings, the main conductor in case the wheel jumps it, will come into contact with the rod and maintain the circuit so that the car can get across the track.

624,971. ELECTRIC MOTOR STARTING SWITCH; E. H. Porter, Ft. Wayne, Ind. App. filed Jan. 19, 1898. This is a device for automatically cutting out the motor in case the current is shut off, or it becomes overloaded; the mechanism comprises two levers working upon the rheostat contacts with a locking device between them under the control of two magnets, one of which is in the main circuit and the other is in the shunt circuit.

624,986. CONTINUOUS-CURRENT SHUNT MACHINE; Adolf Sengel, of Darmstadt, Germany. App. filed Nov. 11, 1898. (See Current News and Notes.)

624,933. ELECTRIC METER; Hans Otto Swoboda, of New York, N. Y. App. filed Nov. 15, 1898. (See Current News and Notes.)

625,014. APPARATUS FOR ELECTRICALLY IGNITING MINERS SAFETY LAMPS; W. Best, Morley, Eng. App. filed Dec. 23, 1897. A conductor extends up through the tubular wick, the terminal being at the top thereof; the wick is surrounded by a metal tube in connection with the lamp frame which is in the circuit; thus when the circuit is closed the spark jumps across the upper edge of the wick.

625,015. BATTERY SOLUTION; H. Blumenberg, Jr., New York, N. Y. App. filed Sept. 17, 1898. The inventor claims that a solution formed of a chlorate of an alkaline metal and a bisulphate of an alkaline metal, is more constant in use and more durable than other solutions; that the zinc is not so rapidly consumed and the current is more intense and continuous.

625,049. ILLUMINATIVE ADVERTISING AND DECORATIVE APPARATUS; T. P. Martin, Liverpool, Eng. App. filed Jan. 17, 1898. A modification of the well-known electric sign, wherein a plurality of contact cylinders are employed for obtaining a variety of effects.

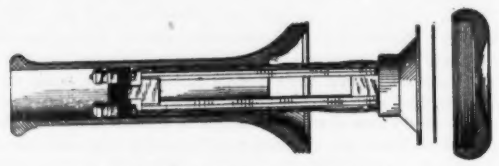
625,060. APPARATUS FOR CONTROLING MOVEMENT OF ELECTRIC ELEVATOR CARS; G. Rennerfelt, New York, N. Y. App. filed Jan. 29, 1898. The invention is designed to control the stopping of a car at the landing, to control the speed when the weight of the car is driving the motor as a generator, to apply a retarding device when the car stops too suddenly. An auxiliary brake is used for applying at the will of the operator; a resistance is placed in the armature circuit and means dependent upon the speed of the motor for short circuiting, the resistance when the motor is driven as a generator by the load, and a device acting instantly upon the motor in case of abnormal speed at starting.

625,098-9. ELECTRICAL DISTRIBUTION BY STORAGE BATTERIES; Justus B. Entz, of Philadelphia. App. filed Feb. 1 and 3, 1899. (See Current News and Notes.)

625,100. SYSTEM OF ELECTRICAL DISTRIBUTION; Justus B. Entz, of Philadelphia. App. filed Feb. 6, 1899. (See Current News and Notes.)

625,142. TELEPHONE RECEIVER; T. C. Burns, Chicago Ill. App. filed Feb. 23, 1899. The magnet of the diaphragm and all internal parts of the receiver are made easily removable from the shell.

625,146. RELAY; J. P. Coleman, Edgewood, Park, Pa. App. filed May 25, 1898. It is stated that in a special form of relay described in a certain application for patent which will sometimes occur when the magnets are



No. 625,142.—Telephone Receiver.

opposite end is to its pole, that only the former end of the armature will be attracted, so that only one circuit will be closed. The object of this invention is to insure the movement of both contact plates against their points under all conditions. This is accomplished by putting a contact plate upon the armature and giving it a certain freedom of movement with respect thereto.

625,151. CONTROLLER FOR ELECTRIC MOTORS; H. R. Davis, of Pittsburg, Pa. App. filed Oct. 28, 1896. (See Current News and Notes.)

625,168. ELECTRIC RAILWAY; Rudolph M. Hunter, of Philadelphia, Pa. App. filed May 9, 1887. (See Current News and Notes.)

625,172. APPARATUS FOR MANUFACTURING MATERIAL HAVING INSULATING PROPERTIES; J. Lamplough, London, Eng. App. filed Nov. 11, 1898. With this apparatus a resin is conveyed into a mass of fibrous material by means of a nonoxidizable oil which will act as a vehicle and have sufficient penetrating effect to carry the resin into the material and thoroughly saturate it.

625,183. ELECTRIC ARC LAMP; P. Mersch, Paris, France. App. filed Nov. 10, 1897. The lower carbon holder is attached directly to the cores of two solenoids, the upper holder is suspended from two cords connected respectively to the opposite ends of said cores.

625,202. COMMUTATOR; J. Risbridge, North East, Pa. App. filed March 22, 1899. To make it possible to renew the surface of a commutator at small expense and to provide for ventilating it, the segments are applied to the surface of a hollow cylinder, the wires leading through the cylinder and then through its wall to the respective segments, the spiders at the ends of the cylinder are made like propellers to create a draft of air through the cylinder.

625,219. ELECTRIC SWITCH; E. Truitt, St. Louis, Mo. App. filed June 20, 1898. A special form of switch adapted to throw the filaments of a multiple filament lamp into and out of circuit and into parallel and series connection at will.

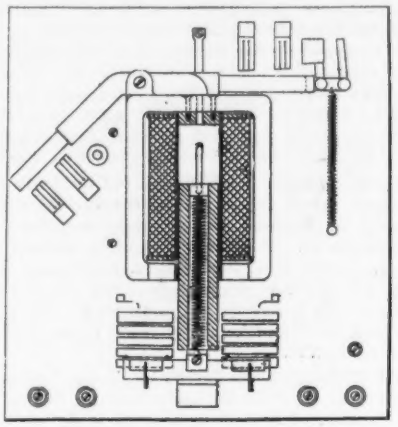
625,223. ELECTRIC RAILWAY SYSTEM; L. E. Walkins, Springfield, O. App. filed Sept. 27, 1897. A section of rails are divided into blocks, the switch controlling the supply of current to each block being operated by a small electric motor.

625,232. NON-ARCING CONTROLLER FOR ELECTRIC MOTORS; A. J. Wurts, of Pittsburg, Pa. App. filed Jan. 31, 1895. (See Current News and Notes.)

625,246. SELF STARTER FOR ELECTRIC MOTORS; H. H. Cutter, Chicago, Ill. App. filed Dec. 27, 1897. The circuit controlling arm moves over a series of contacts; the arm is moved in one direction by gravity and in the other by a spring, a magnet being arranged to put the spring under tension.

625,247. TELEPHONE REPEATER; W. M. Davis, Chicago, Ill. App. filed Feb. 21, 1898. When the direct-connected transmitter is operated, the talking current traversing the primary of the induction-coil induces similar currents in the secondary, which traverse the other telephone line and actuate the receiver thereof. When the transmitter in the local battery-circuit is actuated, talking currents are produced on the line, which traverse the receiver included in the circuit of the connecting device, and the vibration of the diaphragm of the receiver actuates the transmitter situated opposite thereto and the transmitter produces talking-currents which traverse the receiver of the connected line.

625,263. TROLLEY HEAD; A. R. Hitch, Cleveland, O. App. filed Aug. 6, 1897. In order to apply the wheel to the harp without springing the arms



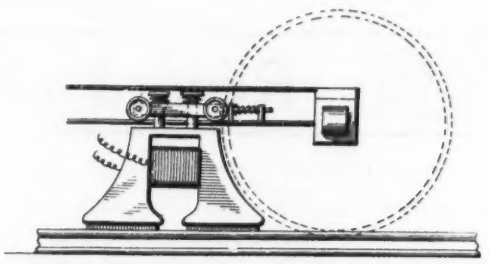
No 625,246.—Self-Starter for Electric Motors.

of the latter, a threaded bolt or axle is used which passes through the wheel and the arms and is held in the latter by nuts, the bolt remains stationary while the wheel turns on ball bearings.

625,264. ELECTRIC HAND FUSE FOR GAS BURNERS; J. Hoffmann & W. Ohlsen, Kiel, Germany. App. filed May 16, 1899. The sparking terminals are applied to an auxiliary burner, which, upon being ignited, is used to ignite the main burner, the terminals then being thrown out of the range of heat from the main burner.

625,281. ELECTRIC RAILWAY SYSTEM; B. Walkins, Springfield, O. App. filed March 7, 1898. The collecting wheel mechanically closes the circuit of a magnet which thereafter holds the circuit to the section closed until the car passes beyond the section.

625,282. ELECTRIC RAILWAY SYSTEM; B. Walkins, Springfield, O. App. filed Jan. 14, 1899. The following is the first claim of the patent. In an electric railway system, in combination, an electric railway comprising the track-rails and terminal or station third rail section and means for supplying a direct current therein and a further third rail section and means for supplying an alternating current therein, a motor car having a direct current motor for propelling it and a second direct current motor thereon, and having an alternating current motor a shoe adapted to receive the current from the direct current third rail and electrical connections for carrying the current from the shoe to operate both said direct current motors a direct current dynamo and electrical connections between the same and the car propelling motor, shiftable mechanical means between the second-named



No. 625,300.—Electric Track and Wheel Brake.

direct current motor and the alternating current motor, a shoe for taking the current from the alternating third rail conductor and electrical connections between this shoe and the alternating current motor and shiftable mechanical connections between the alternating current motor and said direct current dynamo.

625,283. INVERTED THIRD RAIL SYSTEM; B. Walkins, Springfield, Mass. App. filed Jan. 21, 1899. A conductor is located on the under side of an inverted trough suitably supported along the roadway.

625,287. MANUFACTURE OF ELEMENTS FOR SECONDARY BATTERIES; Camille Brault, Clichy, France. App. filed Dec. 29, 1898. (See Current News and Notes.)

625,298. GALVANIC BATTERY; G. W. Frazier, Allegheny, Pa. App. filed April 6, 1898. To avoid using sawdust as a filling, it is proposed to substitute ground carbon, placing it around the carbon electrode.

625,300. ELECTRIC TRACK AND WHEEL BRAKE; G. B. Heath, San Francisco, Cal. App. filed Aug. 27, 1898. A brake shoe carrying a magnetic coil is arranged to have two motions simultaneously, one against the wheel and the other against the track.